JUL 20 1922

Railway Age

DAILY EDITION

FIRST HALF OF 1922, No. 24d NEW YORK—WEDNESDAY, JUNE 21, 1922—ATLANTIC CITY SIXTY-SEVENTH YEAR

Published weekly by Simmons-Boardman Pub. Co., Woolworth Bldg., New York, N. Y. Subscription Price, U. S., Canada and Mexico, $6.00; foreign countries (excepting daily editions), $8.00; single copies, 25c. Entered as second-class matter, January 30, 1918, at the post office at New York, N. Y., under the act of March 3, 1879.

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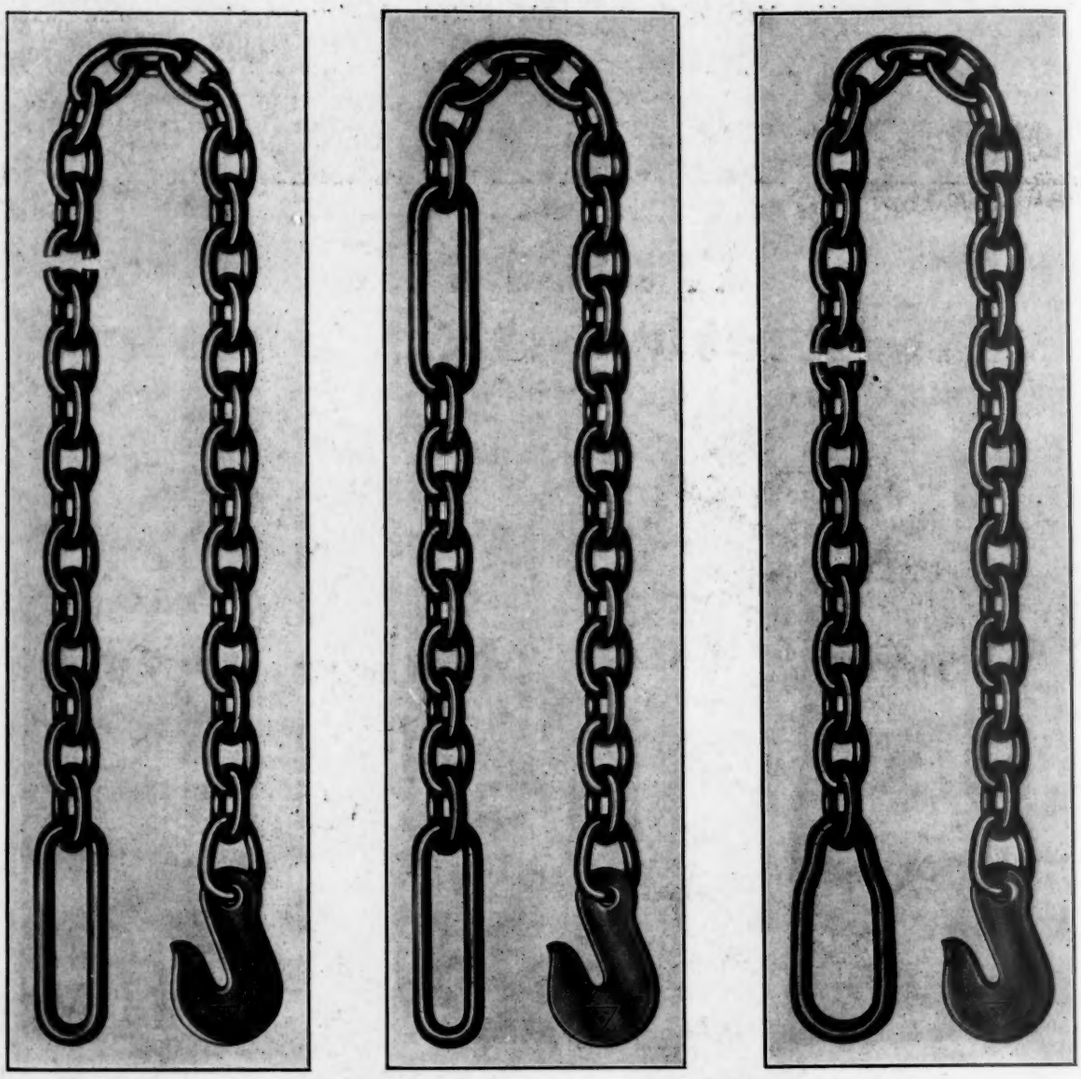

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Copyright, 1922, by the Simmons-Boardman Publishing Company.
VOLUME 72 JUNE 21, 1922 NUMBER 24d

PUBLISHED EVERY SATURDAY AND DAILY EIGHT TIMES IN JUNE BY THE SIMMONS-BOARDMAN PUBLISHING COMPANY, WOOLWORTH BUILDING, NEW YORK.

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Entered at the Post Office of New York, N. Y., as mail matter of the second class.

Subscriptions, including 52 regular weekly issues and special daily editions published from time to time in New York, or in places other than New York, payable in advance and postage free; United States, Mexico and Canada $6.00. Foreign Countries (excepting daily editions), $8.00. Foreign subscriptions may be paid through our London office in £ s. d. Single copies, 25 cents each.

WE GUARANTEE that of this issue, 12,400 copies were printed; that of these 12,400 copies, 10,300 were mailed to regular paid subscribers to the Railway Age and Railway Mechanical Engineer; 110 were mailed to advertisers; 490 were provided for counter and news companies sales, new subscriptions, bound volumes, samples, copies lost in the mail and office use; and 1,500 copies for distribution at Atlantic City.

THE RAILWAY AGE is a member of the Associated Business Papers (A. B. P.) and of the Audit Bureau of Circulations (A. B. C.)

Importance of Personnel Problems

We have commented several times in preceding *Dailies* upon the importance of the foremen and the subordinate officers who come into direct contact with the men in the ranks. Some roads, many of them in fact, have secured excellent results by regularly holding foremen's meetings, discussing not only current detail problems, but often providing for the presentation of special subjects of a more general nature by different foremen. On some roads, for instance, the foremen are encouraged to read the current railway publications which make a special appeal to them, and to report at the meetings on those things which they believe should receive special consideration in their own shop or on their own road. One encouraging feature of some of these meetings is the fact that the discussion frequently gets away from detail shop practices and covers larger problems, such as the management of men and the recruiting and training of apprentices, etc. After all, it is these discussions relating to personnel that will be productive of the greatest results. There is no more important question in industry today. Fortunately an understanding of these problems does not require a college or university training. Pioneers have blazed the trail and the average officer or foreman by well-directed reading and study, and the application of a reasonable amount of common sense, can go a long way in perfecting himself. A dull tool is a poor thing to work with and a little expenditure of energy in sharpening it will produce wonders when it comes to increased production for the expenditure of a given amount of energy. The same principle applies to studying your relationship to the men under you and applying the good things which industry and other departments and railroads have learned as to the management of men. Don't be a dull tool!

Milling—A Production Machine Operation

Much has been said, and justly so, in praise of the modern milling machine because of its accurate production work, As a rule, this machine shows to the best advantage in making duplicate parts. Modern slab and vertical millers are now on the market which would simply open the eyes of railroad men of former days if they could see the cutting feeds and speeds used in machining rods and other heavy locomotive parts. The fork ends of side rods, for example, are now milled with one roughing and two finishing cuts in a small fraction of the time formerly required to drill and slot. But milling is by no means confined to this relatively large work. Experience shows that for planing large numbers of driving boxes, crossheads, shoes and wedges, and other work of a similar type, the milling machine is a most effective tool. An interesting example of what is actually being accomplished with a four-head planer-type milling machine, recently installed in the Beech Grove shops of the Big Four, is described in the December, 1921, *Railway Mechanical Engineer,* page 766. The machine referred to is used mostly for milling driving box shoe and wedge ways and crosshead shoes, assembled on the crossheads. Ten crossheads or 40 driving boxes are machined in eight hours, and the driving box and crosshead requirements of Beech Grove are filled in three days a week, leaving the machine free the remainder of the time for other work. In sizing up a shop to determine what machine operations can best be performed on millers, the plain and vertical knee type milling machine should not be left out of account. These machines are now made rugged, and are accurate, easily-controlled and designed to operate consistently under the heaviest cutting feeds and speeds which high-speed milling cutters will stand.

Must a Machine Tool Be Operated Continuously?

The statement has been made that if the installation of any machine tool will show a return of 15 per cent on the investment and the facts can be presented before the proper authorities, necessary funds will be available for purchasing the machine. The question is how to determine exactly what saving will be effected by a machine and this involves some more or less careful calculations regarding the present cost of doing work and what the cost will be as done on the new machine. The time element is a direct factor in possible savings as it is evident that if a machine can perform a certain operation in 30 min. (including the time for setting up work, sharpening tools, etc.) at a saving of 25 cents, the total saving in an eight-hour day will be 16 times 25 cents, or $4.00. There are many practical men who have a violent antipathy to machine tools standing idle and it is true that if they are idle either all or a large enough proportion of the time, interest charges on the investment and depreciation will represent an in-

creasingly heavy loss. While it is desirable to keep machines running all the time (in which case maximum savings are effected) there is no justification for arbitrarily refusing to install any machine simply on the ground of lack of work to keep busy all the time. It is simply a case of applying common horse sense and balancing relative costs. In the particular case cited, for example, it may develop that a saving of $3.00 a day will provide the required 15 per cent return, in which case the machine would have to perform the operation 12 times (in six of the eight hours). If there is enough work to keep this machine busy for six hours a day, install it even if it has to stand idle the other two hours. Any work which is done in those two hours represents a net return over and above 15 per cent. There is another factor which should not be forgotten, namely, that almost any type of modern production tool after being installed is eventually utilized for other work besides that for which it was purchased. It is often found adaptable for unexpected uses and can then sometimes be run on two or more shifts, in which case the net return to the company is just so much greater.

Check Your Reclamation Work

The past two or three years has witnessed a wide variation in labor and material prices and unless careful checks have been made at some recent date, there is probably not a railroad reclamation plant in the country at which some parts are not now being reclaimed at a loss. It is important that a continual check be kept on reclamation operations because, while there is a possibility of great saving, there is also a possibility of great loss when attempting to reclaim scrap at excessive labor or other cost. Every item should be subjected to critical examination in view of the changing labor and material prices. The determination of what it pays to reclaim and what is not worth reclaiming can be arrived at only by an accurate knowledge of prevailing material prices and the actual cost of reclamation work. Among other things a careful check should be made to see that no material is sent to central reclamation departments if not suitable for reclaiming. Failing to do this may result in unnecessary handling charges and transportation costs. The way this particular feature of reclamation work is handled on the Chesapeake & Ohio is described by E. A. Murray, shop superintendent at Huntingdon, W. Va., in an interesting article in the June *Railway Mechanical Engineer*. The inspectors on that road examine all scrap material, marking each piece which is suitable for reclamation with white paint and each piece which cannot be reclaimed with yellow paint. In this way all the material reaches its proper destination without back travel or rehandling in any way. Scrap reclamation is a highly important subject and one which must be watched closely, otherwise material will be reclaimed at a cost which is greater than required to buy the parts new.

Heat Treating Equipment and Experts Needed

Railroad shops are not as a rule provided with enough modern heat treating equipment, including suitable furnaces, pyrometers and quenching mediums. While heat-treating methods are primarily for tools, certain roads are heat-treating rods and other parts of the motion work. In both cases the best qualities of the steel cannot be brought out unless the proper heat treatment is given. Guess-work methods must be eliminated and replaced by modern methods to accomplish the results desired. High-speed steel is entirely too expensive to be spoiled, and not only are tools spoiled when given improper treatment, but there is a big loss due to inefficient or spoiled work. A word may well be spoken, in this connection, for the tool makers who heat-treat railroad tools. Most of these men have read about and studied the heat treatment of steel, otherwise they would be unable to get the results desired; they should be encouraged by the managements as much as possible to extend their studies. The sectional and annual meetings of the American Society for Steel Treating afford a valuable opportunity for tool makers to broaden their knowledge of the art and the net return to the railroads will justify the expense necessary to send these men to the conventions. It is a short-sighted policy to place anything in the way of tool makers acquiring this additional information. In a specific case a young tool maker who had acquired considerable skill decided to attend the annual Steel Treaters' convention, being graciously accorded permission to go, with transportation afforded him. The traveling expenses, however, aside from transportation, had to be taken out of his own pocket and he was not paid for the two days he was away. If the rules of the railroads are so inflexible that no provision is made for a case of this kind it is certainly time for some radical action. Shop superintendents should have authority to send their men to such meetings with all expenses paid and wages continued, where the information gained may be worth to the railroads many times what it cost.

Stores Department Turnover

The necessity of keeping the percentage of turnover of material purchased by railroads as high as possible for a given period is self-evident and needs no supporting arguments. Each year the railroads spend an increasingly large proportion of their gross revenue for material, and in 1920 this proportion reached 17.3 per cent, or slightly over one billion dollars for Class 1 roads; this is exclusive of coal. On railroads having well organized and efficient stores departments the material turnover is in the neighborhood of 25 per cent a month, whereas the turnover on roads not giving the same attention to their service of supply may be only 12½ per cent a month, or lower. This means that if two roads in these respective classes are of the same size the latter road carries its material just twice as long as the former and therefore pays twice the interest on the investment to say nothing of depreciation, obsolescence and handling costs. These latter factors are all extremely important and furnish additional reasons for making the turnover percentage as high as possible. Material held in stock too long becomes obsolete and then is good only for the scrap bin. Many kinds of material depreciate rapidly even with the best of care. Costly as the practice is, metallic parts and bar stock are often stored outdoors where they rust and deteriorate rapidly when subjected to inclement weather conditions. For example, spring steel stock has been known to rust and corrode to such an extent that it was valueless. This condition is often accentuated by the fact that new stock is added to old piles and when a requisition is received for this class of material it is always taken from the top of the pile with the result that material at the bottom never gets used, or at least not for a long period. If this material is of a kind subject to corrosion or deterioration it eventually becomes valueless. Rubber hose and other rubber goods furnish an additional example of material which deteriorates rapidly even when stored with the greatest care and it is doubly important therefore to ob-

tain a quick turnover on this class of goods. In view of the amount of money involved and the possible savings it is practically impossible to place too much emphasis on the need for a high percentage of turnover of stores department stocks.

Supervision of Small Boiler Plants

The modernization of the large power plant or the selection of suitable equipment for the new power plant is very largely an engineering problem and the benefits of wise planning are continuous as long as the plant remains in service. Even the supervision of the large plant to insure that the maximum efficiency of which the facilities are capable be continuously developed, is a comparatively simple matter. But the small boiler plants located at engine terminals and small shops, widely scattered over the railroad lines and operated by forces of indifferent ability, present a much more serious problem. In the aggregate it is not improbable that these plants consume more fuel than the comparatively small number of plants large enough to be equipped with adequate modern facilities. The need for some system of supervision over the operation of these plants was brought out forcefully in the discussion on stationary boiler plants during Tuesday's session of the Mechanical Division, by the experience of one railroad on which a careful check of the steam requirements of a small plant brought to light the fact that about 40 per cent of the total steam consumption was accounted for by radiation and leakage losses. The situation was one which no doubt would have justified a considerable expenditure for the improvement of facilities, but the pertinent fact is that means were found whereby the standby losses during the time when the shop was not operating could be very largely eliminated without the necessity of making any capital expenditure whatever. For roads of considerable mileage this situation is one which can best be handled by a staff supervisor whose duties require him not only to check the performance of the power plant operators, but also periodically to make a careful survey of the power requirements and the condition of all steam generating and power distribution facilities. The benefits to be derived from the work of such a supervisor will in large measure depend on the selection of a man with the right personality. His methods must be those of persuasion rather than of force and results will be measured by the extent to which he is able to secure the co-operation of local shop and division officers. The field of such a supervisor should include water service stations and plants under the jurisdiction of other departments as well as the mechanical department.

The College and the Railroad

The problem of the college man in railroad service has been under discussion for many years and at the present time the results of the efforts to induct these men into the service of the mechanical departments, is even more unsatisfactory than ever before. A few roads continue to take a limited number of mechanical engineering graduates into their service as special apprentices. But, although it is beyond question that the railroads need recruits who have trained minds and a thorough grounding in the fundamentals of engineering, it is a fact that other industries continue to take the pick of the college men. Is it impossible to develop satisfactory methods of academic training or to find a practicable means of enlisting the product of the engineering schools in railroad service? The instructors and executives of the engineering colleges of the country have organized the Society for the promotion of Engineering Education, and this body has a committee, the purpose of which is to consider this and other questions pertaining to special apprenticeship on the railroads. Here is an opportunity to remove the lack of understanding by the engineering schools and the railroads of each other's problems, by their joint consideration, if a committee representing the Mechanical Division were to act with the special apprenticeship committee of the society. The colleges are as much in need of this sort of co-operation as the railroads. It is essential for the development of effective academic work that the schools have a clear vision of the opportunities for college men in railroad work, to what extent specialization in railway mechanical engineering should be carried, and what schools should be encouraged to develop the special courses. Should these courses be confined to purely engineering subjects or ought they to include a groundwork in the economics of railway transportation? These are all problems in the solution of which the advice of the practical leaders in the railway field is needed. On the other hand, the railroads have much to learn as to the proper development of the special apprentice after he has entered the service. Is it not as essential that the special apprentice be required to follow a regular course of study to supplement the practical work to which he is assigned, as it is that the regular apprentice be required to apply himself in this manner? There are doubtless many other specific questions which would be developed by joint inquiry if representatives of the two organizations were to come together with a serious purpose to understand and help each other.

Turbine Locomotive Possibilities

One of the radical forward steps in locomotive development taken during the past year has been the application of the steam turbine to the locomotive. To be sure, the suggestion is not really new and several early and poorly worked out attempts were made a number of years ago, but until last year little of consequence had been accomplished. The rapid increase in the cost of fuel as a result of the world war has brought out a demand for many changes in engineering practices which formerly were given only superficial attention. Economies in locomotive operation have assumed increasing importance and European designers have seriously attacked the problem of perfecting the turbine locomotive, with the result that locomotives of this type are now in regular operation in Sweden, England and Switzerland and are under construction in other countries. No detailed information in regard to the designs is yet available and only meager data concerning steam and coal consumption have been given out. There has been sufficient, however, to make it certain that the efficiency is far ahead of anything previously obtained from a steam locomotive. No one expects that these early applications will be perfect in design and it may take years before certain mechanical difficulties are overcome. We have in this country engineers who have done much to bring the locomotive to its present stage of development, also those who have aided greatly in perfecting the turbine. Instead of waiting for European engineers to develop the turbine locomotive and thereby losing several years' time as we did waiting for them to develop the superheater, feedwater heater, outside valve gear and many other locomotive features, why not undertake some of the real pioneer work in this country? The incentive is there and the returns from success are bound to be large.

Program for Today

Three railroad conventions will be in session in Atlantic City this morning.

Division VI, Purchases and Stores, A. R. A.

This meeting will be held in the Hotel Traymore and will be called to order sharp at 9:00 a.m.

	A.M.	A.M.
Discussion of Reports on:		
Subject 13—Forest Products	9:00 to	9:30
Special Subject, "The Need of a Sinking Fund to Care for Deterioration, Obsolescence, and Other Losses Incidental to the Handling, Use and Distribution of Materials," by H. H. Laughton	9:30 to	9:50
Subject 15—Buildings and Structures and Facilities	9:50 to	10:00
Special Subject: "Office Routine in Purchasing and Stores Departments" by E. W. Thornley	10:00 to	10:15
Special Subject: "Stationery, Including Repairs to Typewriters," by C. B. Tobey	10:15 to	10:45
Special Subject: "Educating Employees of the Store Department for Their Duties," by A. S. McKeligon	10:45 to	11:15
Special Subject: "The Human Equation in Railway Service of Supply," by M. J. Wise	11:15 to	11:30
Subject 19—Fuel Conservation Joint-Committee	11:30 to	11:45
	M	
Report of Memorials Committee	11:45 to	12:00
	P.M.	P.M.
Report of Resolutions Committee	12:00 to	12:15
Report of Nominating Committee	12:15 to	12:30
Election of Officers	12:30 to	1:00

Division V, Mechanical, A. R. A.

The meeting will be held in the Greek Temple on the Million Dollar Pier, and will be called to order sharp at 9:30 a.m.

Discussion of Report on:
Design and Maintenance of Locomotive Boilers.
Subjects Referred for Discussion.
Closing Exercises.

Air Brake Association

The meeting will be held in the Vernon Room of Haddon Hall and will be called to order sharp at 9:00 a.m. This is done in order to permit of an early adjournment so that those who so desire can leave immediately after lunch.

The two papers which will be presented for consideration are the reports of the Committees on Recommended Practice and on Triple Valve Repairs.

The annual election of officers will follow the presentation of the papers.

Entertainment Features

10:30 a.m.—Orchestral Concert, Entrance Hall, Million Dollar Pier.

Lost and Found

Lost—An earring. Please return to Mrs. Argyle Campbell or to Secretary Conway's office.

Lost—Badge 5622. Return to John L. Nicholson, Locomotive Fire Box Company.

Lost—A round pearl, sapphire pin. Please return to Miss Mildred Tucker, Booth 24.

C. A. Seley reports the loss yesterday of a malacca cane with a silver handle, which has been his constant companion at the conventions for years. The finder is requested to leave it at the *Daily Railway Age* booth.

Registration Book

So many people registered yesterday that the executive committee of the R. S. M. A. decided to issue another enrollment list this morning.

Appreciation of Good Work

The executive committee of the Railway Supply Manufacturers' Association yesterday showed its appreciation of the good work done by its retiring president, J. F. Schurch, and its secretary, John D. Conway, in a substantial manner. It presented Mr. Schurch with a pair of white gold cuff links set with diamonds, and Mr. Conway with an amber-headed cane.

Annual Purchases and Stores Ball

The annual Purchases and Stores Division grand ball which was held on the Pier last night, was largely attended and every body had a good time. The committee in charge was composed of N. C. Naylor, chairman, Lewis C. Cameron, W. G. Cook, C. W. Floyd Coffin, W. J. Doherty, A. N. Dugan, Oscar C. Hayward, George A. Nichol, Jr., Leslie R. Pyle, W. R. Walsh and W. M. Wilson.

G. S. Edmonds Elected President of Cornell Alumni

Thirty enthusiastic alumni of Cornell University met at the Traymore on Monday evening for the dinner of the Cornell Association of Railway and Supply Men. Among those present were several who had attended class reunions at Ithaca last week and A. R. Ayers, president of the association, called on a number to tell of their experiences while visiting their alma mater. The officers elected for the ensuing year are: President, G. S. Edmonds, superintendent motive power, Delaware & Hudson; secretary, A. F. Stuebing, *Railway Age*.

Enrollment Today

The enrollment booth at the entrance to the pier will be open from 9:00 a. m. to 11:00 a. m. this morning.

Invitation From E. S. B.

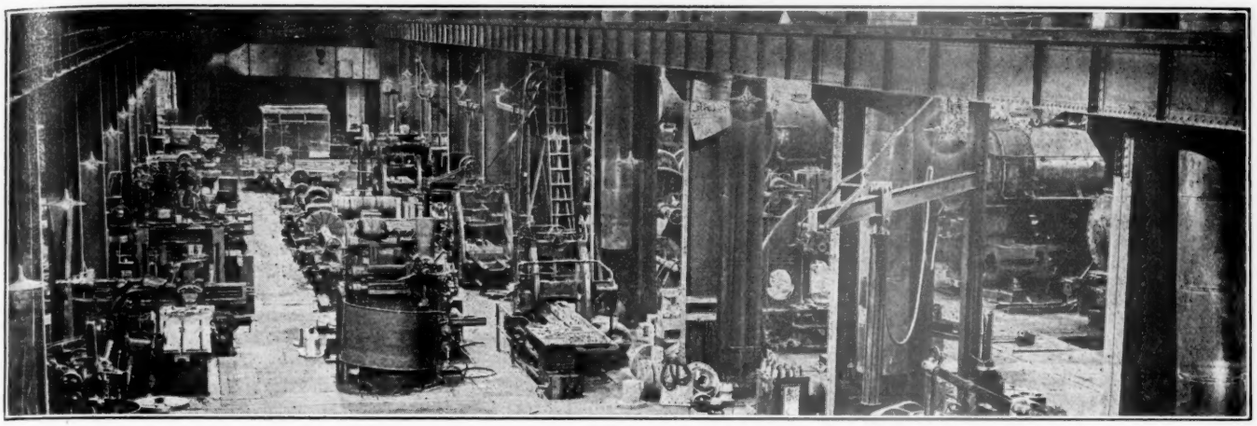
The Electric Storage Battery Company, Philadelphia, Pa., extends an invitation to convention attendants to visit its factory at Nineteenth street and Allegheny avenue, Philadelphia, Pa., on Thursday, June 22.

Additional Exhibitors

Dielmore Valve Company, Philadelphia, Pa.—Automatic drain and relief cocks. Represented by R. A. Parkinson. Space 528.

Johnson Manufacturing Company, Urbana, Ohio.—American railway standards of tinware, including locomotive oilers, tallow pots, sprinkling cans, oil containers, signal guns, etc. Represented by Isaac T. Johnson and H. W. Jacques. Spaces 328-330.

National Graphite Lubricator Company, Scranton, Pa.—Type *B* National graphite lubricators. Represented by H. H. Brady and L. S. Watres. Space 24.



American Railway Association—Division V—Mechanical

Reports on Locomotive Construction, Feed Water Heaters, and Boiler Plants on Tuesday's Program

Chairman Coleman called the meeting to order at 10 a.m.

Report on Locomotive Construction

The committee's report is in effect eleven separate reports on as many separate subjects, all pertaining to locomotive details or appliances, except one, which presents a comparison and summary of the various formulas for calculating the tractive effort of Mallet locomotives.

In few cases do the committee's investigations indicate the practicability of making definite recommendations. The definite conclusions are to the effect that the life of the flanged bottom tank will be longer than that of the bottom riveted type; that an automatic drifting valve is desirable if one can be developed which will operate successfully both at high and low speeds, without undue maintenance costs; that the tank syphon is adapted for use with lifting injectors, and tank valves with non-lifting injectors; and that metallic feedwater connections between engine and tender need further development.

THE COMMITTEE this year has confined its report to the study of various details of locomotive design and construction which have been referred to it. Each of these subjects is reported upon separately under the following headings.

The tractive effort of Mallet locomotives working simple has been considered and it is not believed advisable to recommend a uniform formula. Mallet locomotives with an intercepting valve design to allow steam from the boiler to pass direct to the low pressure cylinders and the exhaust from the high pressure cylinders direct to the stack permit an increase of approximately 20 per cent in the tractive effort of the locomotive. This calculated increase is not available unless the factor of adhesion is high enough to prevent the wheels from slipping. Where the factor of adhesion is low, it would be more practical to divide the weight on the driving wheels by about 3.8 and determine the tractive effort in simple operation on this basis.

The railroads can best determine for themselves what tractive effort to choose in simple operation dependent upon the design and weights on drivers of the locomotive.

There are other variables that could enter into a formula such as the compounding system, travel and valve setting, kind of valve gear, but it does not appear advisable or necessary to take all of these into account.

The American Locomotive Company's formula for the tractive effort of Mallet locomotives working compound is based on a total M. E. P. of 91 per cent. of the boiler pressure. The Baldwin Locomotive Works' formula is based on a total M. E. P. of 85 per cent. of the boiler pressure. The I. C. C. formula for Mallet locomotives is based on a total M. E. P. of 94 per cent. of the boiler pressure.

To illustrate the difference in formulae for compound working, the tractive effort has been calculated for five-different Mallet locomotives in the table, in which

C = diameter of high pressure cylinders in inches
c = diameter of low pressure cylinders in inches
S = stroke in inches
P = boiler pressure in pounds
D = diameter of driving wheels in inches
R = ratio of cylinder volumes
K = a constant
T = tractive effort working compound at maximum cut-off and low speed

Locomotive	Type	Cylinders C c S	P	D
A	2-6-6-2	20-½-33 x 32	210	57
B	2-6-6-2	21-½-34 x 32	200	57
C	0-8-8-0	26 -40 x 28	220	51
D	2-8-8-0	25 -39 x 32	240	57
E	2-6-6-2	23 -35 x 32	225	57

Locomotive	A. L. C.. $T = C^2 \times S \times \frac{K \times P.}{D}$	B. L. W. $T = C^2 \times S \times \frac{1.7 \times P.}{(R + 1) D}$	I. C. C. $T = (\frac{2}{3} C^2 + \frac{1}{4} c^2) \times S \times \frac{P.}{D}$
A	64,320	60,779	65,127
B	66,715	63,044	67,050
C	103,333	97,580	102,747
D	107,386	101,464	107,374
E	84,022	79,338	83,231

Broken Frames and Suggested Remedies

In but a few instances will it be found that the breaking of frames can be ascribed to method of attaching boilers to frames. Usually locomotives remain in service several years before frame failures occur, and possibly there will then be an epidemic, indicating that time is an element. Investigation of failures on different classes of locomotives on one railroad, indicated that the principal zone of failure was in the neighborhood of the main wheel, or ahead of the front pedestal, and little trouble occurred at the point where furnace is attached to the firebox.

If locomotives are designed with frames of proper strength to withstand stresses, little trouble should be experienced with broken frames, if a locomotive receive necessary running maintenance. Neglect of loose pedestal binders, loose wedges and worn rods, result in many frame failures.

Locomotives have been designed with insufficient frame crossties and crossties deficient in strength, or improperly located so that frames are not properly tied together. When many of the older locomotives were designed, the art had not advanced to a sufficient degree to clearly understand the varied stresses set up in locomotive frames, and undoubtedly there is much yet to be learned in this respect.

The vertical loads due to the dead weight carried, as well as the vertical, longitudinal and lateral loads caused by the piston thrust, brake equipment, etc., produce strains that cannot be completely analyzed. This, therefore, requires that the frames be designed with very low stresses per unit of section, or very liberal sectional areas, to allow for these unknown forces. The frame, frame bracing and boiler when fastened together, should form a rigidly connected structure, and in whatever direction the thrusts may be applied, it must retain a fixed relation of one part to another.

The springs and spring equalizer rigging must provide the necessary flexibility and absorb the stresses which are imposed on the locomotive laterally, due principally to centrifugal forces on curves, and the reaction of the guiding effect of the engine truck, which is concentrated at the first frame pedestal as a fulcrum, with its resulting lateral bending stresses in the frame, between the pedestal and the cylinder. The longitudinal flexibility, due to brake application, is likewise absorbed in the spring rigging, as well as the vertical pressure due to the dynamic augment resulting from the driving wheel counter-balance.

The pressure due to the piston thrust produces vertical pressure on the guides. This guide construction, must form a rigid framework in itself, as the fatal results from any flexibility in the working of these parts will be easily understood.

The bracing of the frames should be applied as closely as possible to the points of application of pressure in the various directions. It is most improper in designing frames simply to add metal to prevent breakage, instead of designing to absorb the stresses in the proper manner. The adding of weight to the frames would serve practically no purpose in remedying frame breakages. On certain existing locomotives, the addition of one or more waist sheets would have a beneficial effect. It must also be kept in mind that if a sliding bearer is used under the front and back of the furnace, it should be provided with brass bearings. Otherwise it is liable to become corroded and stuck, in which case broken frames are apt to result. When the top waist sheet angle is riveted to the boiler, and also to the waist sheet plate, there have been many instances where it was most difficult to keep either bolts or rivets in the top or bottom of the waist sheet plates. This difficulty has been overcome by applying support that is flexible at the boiler, so made that the boiler merely rests upon a bearing, which is free to move when the boiler expands.

Vanadium steel is being used by some railroads which claim advantage from use of this material. In 1914, the Committee on Use of Special Alloy and Heat-treated Steel, reported in a general way the working fibre stresses as used by the locomotive builders for frames, as well as other parts. So far as locomotive frames are concerned, the practice is still in use, though more or less elaborated. The American Locomotive Company formula is:

$$S = \frac{T}{C}$$

Where S = section area of frame
T = piston thrust
C = constant (see table below)

	S	C
	From cylinders to main pedestal, including top rail over main pedestal	Back of main pedestal
A—Top of Pedestals	2,500-2,700	2,900-3,200
B—Top rail between pedestals	3,000-3,200	3,500-3,800
C—Lower rail between pedestals	4,300-4,500	5,100-5,300
D—Integral single rail at back of cyl. keying lug	1,600-1,800	.....

This method gives sectional areas back of main pedestal approximately 15 per cent. less than similar areas at or ahead of the main pedestal. The depth of the top rail ahead of the front pedestal must not be less than that of the top rail over the front pedestals. In general, these stresses are used regardless of whether the material is open hearth carbon steel or vanadium cast steel.

Some of the steel companies are at this time in position to furnish one piece cast steel locomotive bed, which does away with many of the undesirable features of present frame design. The main advantage, however, is stronger frame with less weight, and it would seem to be a very great improvement over what has heretofore been used.

Slide Valves On Mallet Locomotives

In early locomotives of the Mallet type the "D" slide valve was used on the low pressure cylinders. In the early service when used as pushing locomotives, there was no particular trouble experienced with the cutting of the low pressure slide valves and cylinders. As these locomotives were employed in road service, the cutting of the slide valves in the low pressure cylinders developed. The piston valve was then resorted to to overcome this trouble, and locomotives already built with slide valves, had brass valves applied on cast iron seats or brass false seats applied to the cylinders, on which the cast iron slide valves worked. This effected considerable improvement, and reduced the cutting of these parts, but trouble was still experienced with the low pressure cylinders cutting.

Attention was then directed to the system of lubrication employed with a view of overcoming the cutting.

The different methods of application of lubrication to the cylinders and valves which have been tried have not proved satisfactory, and the problem is yet to be solved.

There is being tried out a new lubricant recently placed on the market, to be delivered through a hydrostatic lubricator, in which graphite is employed, the graphite being broken up so fine that it is readily held and carried in suspension with the lubicating oil, the claim being that the graphite will adhere to the surfaces lubricated, thereby forming a coating, which prevents cutting of the metal. As graphite lubricant on bearing surfaces has proved to give good service, we may reasonably hope that the methods now being used will demonstrate that graphite is a satisfactory lubricant for steam surfaces, and the committee will follow this up with interest.

Extended Piston Rods

Extended piston rods have been tried out with more or less success on a large number of American roads as a means of reducing cylinder and piston wear. Any means employed for relieving the cylinder and piston from the weight, shock and consequent wear attendant upon a free piston, would seem to be a direct benefit. If it were always possible to preserve the alignment on both ends of the rod, the extended piston rod would be beneficial in preventing cylinder wear and would also permit the use of cast steel, thereby resulting in some reduction in weight. On the other hand, the extended rod itself results in considerable increase in weight, which seriously complicates the question of counter balancing.

Two general methods have been resorted to in treating the extended piston rod; one, the use of another metallic packing on the front cylinder head, while the other employes an extension sheath in which the piston rod is permitted to reciprocate the bronze or other suitable form of bearing at the inner end of this sheath to take the weight of the rod and piston. In the former

case the upkeep of an extra metallic packing is a serious objection, while in the latter case the steam clearance is considerably increased, and it is difficult to design a bushing of sufficient bearing to prevent rapid wear.

On one road at one time having a large number of Vauclain compounds, extended piston rods of sheath type were introduced, but the upkeep on bushings was estimated to be higher than the natural wear that would have taken place without the extended rods. On this same road several years ago the problem arose of equipping large locomotives with 29½-in. cylinders, and the question of extended rods was seriously considered. After looking up all data available at that time, it was decided that instead of using extended rods, to bronze the entire circumference of the cast steel Z-type piston. This was applied to a number of 2-10-2 type locomotives, and the results have been most satisfactory. These engines have been in service since 1917, and up to date have made an average of 112,000 miles each. These engines still have the original pistons, which require re-bronzing about every ten months. In no case has cylinder wear been excessive, and the problem of lubrication, or rather the problem of running pistons at times without lubrication, has been simplified.

On another road it is ascertained that the benefits depend to a large extent on maintenance, and the fact that if main crosshead and extended piston rod crossheads are properly maintained, the piston head will be carried in the cylinder without wear. On this road there appear to be records where the mileage has been as high as 137,000 miles without cylinders being bored. It is the judgment of officers of this road that cylinders of 25 in. and over in diameter should be equipped with extended piston rods.

Another prominent road reports that it has investigated extended piston rods, and it is a question whether they are of any material advantage. They have, therefore, arranged to remove them.

The committee believes finally that as there seems to be a diverse opinion as to the merits of extended piston rod, definite conclusions should be deferred and more investigation made on this subject.

Solid Bushed Front End Main Rods

For the purpose of securing data in connection with this subject, a number of Railroads and also the locomotive builders were asked to submit information on the following questions:

(1) What design of front end of main rod do you use, solid front end of main rod with bushing, or keys and two piece brass?

All replies but three state they are using the front end of main rod design of keys and two piece brass only, and that the service from this design is entirely satisfactory. Three of the roads use both designs.

The builders state that several years ago quite a number of roads had locomotives equipped with solid front end main rod and bushing, but have since gone back to the use of keys and two piece brass on account of the solid bushing not giving entirely satisfactory service.

(2) What kind of lubrication of oil or grease, or both, do you use?

All replies except one state that both oil and grease are used. On the lighter locomotives oil is used and on the more modern locomotives they are internally lubricated by grease through the wrist pin. One road uses oil on all classes of locomotives. Roads which are using grease are getting satisfactory service.

Flange vs. Riveted Tank Bottom

The sub-committee appointed to investigate the construction of locomotive tenders with flanged bottom tanks, compared with the usual method of construction by the use of the angle irons and lap joints, has collected from various railroads, and has also made personal investigation. It is the opinion that the flanged tank possesses certain features of distinct merit, as enumerated below:

(1) The top and bottom sheets of the tank are flanged so that rivets are horizontal. By this method the angel and tee irons are dispensed with.

(2) The design appears to prove more rigid construction and permits of better interior bracing. The interior parts are secured to the upturned edges of the sheets.

(3) There being no rivet holes through the bottom of the tank, the cost of repairs should be materially reduced, as it is unnecessary to lift the tank from the frame to repair leaks, which is frequently required with tank bottoms constructed with flat seams vertically rivited.

(4) The claim is made by certain railroads that the construction of the flanged bottom tanks is less expensive by 6 per cent than construction of tanks with lap joints. Locomotive builders, however, consider it would cost more to build the flanged tank. Much depends upon the number of tanks to be constructed at one time, and the proper tools for forming sheets. It would appear from the design that there may be some saving in labor and material such as rivets, etc.

(5) There has been some question concerning the strength of the corners and difficulty in repairing them, if same become weakened by corrosion or cracking. Our best information, however, from the users of such tanks, indicates that corners are sufficiently strong and that no difficulty is experienced in repairs.

After careful consideration, your committee feels that the efficiency of the flanged tank should be equal to the old style of construction in every way. It is felt that ultimate life should be somewhat extended, and that the cost of construction should be no greater. Leaky tanks are Federal defects, and any design that will eliminate liability of such leaks is a desirable improvement.

Mikado vs. Consolidation Engine

The first locomotives of the Mikado type were built by The Baldwin Locomotive Works in 1897, for the Nippon Railway of Japan; in 1902 a locomotive of similar type was built for the Bismarck, Washburn and Great Falls Railway in the United States.

The Mikado type locomotive permits the use of a long boiler with a wide and deep firebox, which is placed back of the driving wheels and over the trailing truck. This form of firebox is especially suitable for burning high volatile coal, as there is sufficient furnace volume for the combustion of the gases before they enter the tubes. Cases are on record where Mikado type locomotives have successfully burned fuel of a quality too poor for use in Consolidation type engines of equivalent hauling capacity, but having smaller fireboxes.

With a given weight on driving wheels and equal ratios of adhesion, a Mikado type locomotive will show no superiority over a Consolidation type, as far as starting tractive effort is concerned. As the speed increases, however, the tractive effort of the Mikado type will fall off less rapidly than that of the Consolidation, because of the greater boiler power of the former locomotive. On some roads the Mikado type locomotive has made an excellent combined passenger and freight locomotive, being used interchangeably for either service as occasion requires.

The Mikado engine, on account of its wheel base arrangement, is somewhat easier on flange wear, and somewhat safer in high speed without danger of derailment.

On Consolidation type locomotives having wide fireboxes, and comparatively large driving wheles, the depth of the furnace throat is necessarily restricted, making it difficult to apply a satisfactory design of brick arch. This difficulty is avoided in the Mikado type, as there is ample space between the grate and bottom row of flues for an arch with its supporting tubes. The necessity of placing a driving wheel under the firebox makes it practically impossible to apply a satisfactory ash pan to the Consolidation type because the pocket over the driving wheel is so close to the underside of the grates.

Relative Advantages of Non-Lifting and Lifting Injectors

For the purposes of securing data on this subject a questionnaire was prepared and sent to sixteen railroads from which eleven replies have been received. The advantages of the non-lifting injectors are reported as follows: (1) Larger capacity for same size injector, injector pipes and connections; (2) grades closer, giving a wider range for each size of injector; (3) gives less trouble from restricted openings in the feed water supply pipe; (4) located on the outside of the cab, thus relieving congested conditions inside; (5) more reliable and dependable; (6) application and maintenance cost less; (7) more accessible for repairs and repairs can be made on the injector in place without disconnecting from the piping; (8) will work with less water in tank, also operate with feed water at a considerably higher temperature.

The disadvantages of this type injector are its greater liability

to being knocked off by derailment, side swipe, etc., and the liability to freeze in extremely cold weather.

The advantages of the lifting injectors are stated as follows: (1) Mounted in cab where engineman can more easily see and observe its workings; (2) if trouble occurs on the road it is easier for the engineer to remedy it; (3) self contained and fewer parts to operate; (4) easier operated and controlled.

Its disadvantages are: (1) Less grading range than the non-lifter; (2) more readily affected by restricted feed water opening and length of lift; (3) must be taken down from pipe connections to repair the tubes; (4) tubes coat up more rapidly than in the non-lifters; (5) it is subject to failure from a leaky boiler check, worn steam nozzle or combining tube, leak in feed pipe, or if injectors become overheated they must be cooled off before they will operate.

It would appear from the replies received that:

(a) Little is known about the comparative efficiency of the two types of injectors with respect to steam consumption for a given quantity of water delivered; (b) The cost of repairs and maintenance is less with the non-lifting injector; (c) The non-lifting injector is more easily located and repaired; (d) The non-lifting injector is generally considered preferable and is gaining in favor, particularly on large locomotives.

Saturated Steam Drifting Devices For Superheater Locomotives

For the purpose of securing data on this subject a questionnaire was prepared and sent to 16 railroads from which 14 replies have been received. It would appear from replies received that: (a) Automatic drifting valves on superheater locomotives are not generally being used; (b) the common practice when drifting is to crack the throttle; (c) the use of the manually controlled steam line from cab to valves and cylinders has not proven satisfactory; (d) some roads are using home made devices for supplying air compressor exhaust steam to valves and cylinders with satisfactory results; (e) a few roads are using automatic drifting valves with apparent success; (f) a few roads are experimenting with various forms of automatic drifting valves; (g) an automatic drifting valve is desirable if one can be found or developed which will operate successfully both at high and at low speeds, and be simple and rugged enough to be reliable and stand the service requirements without undue maintenance cost.

Tank Syphons Versus Tank Valves

In order to determine modern practice of representative railroads, a questionnaire was prepared and sent to 24 railroads, from which 16 replies have been received. Summarizing the data submitted by the various railroads, it appears to your committee that the syphon is well adapted for use with lifting injectors, while the tank valve is more suitable for non-lifting injectors.

Tank Hose vs. Metallic Connections

To our inquiry regarding the subject, nine replies were received from railroads and one voluntary report from a manufacturer. All of these roads but one, were large systems. Five roads had no experience whatever with metallic tank connections. One road reported trying out one in 1909 without success. Another road has tried one on a switch engine for three years with no cost for repairs beyond three or four gaskets and their application. The Erie has one connection applied to engine No. 2509. This has been in service for the last 18 months. The test is to cover a period of two years. One large system reported having had "a little experience" with metallic tank connections, adding "We are not extending it."

From our study of this subject it appears that metallic connections for steam, air and signal lines are almost universally used. All of the roads but one reported unanimously in this regard. None of the present devices are heartily endorsed sufficiently to warrant your committee in making a recommendation.

The maintenance of tank hose amounts to very little if it is manufactured of first class material and properly applied. Tank hose suffers more from abuse than from use. It is put up wrong as often as it is put up right and is in many instances a badly neglected detail. If the hose connections are properly angled and the hose cut to proper lengths, the kinking will be reduced to the minimum and the maintenance likewise, as it is the kinking of this stiff wire-lined hose that destroys it. Standard diameters and lengths are easily maintained, but in the application the drawing cannot be adhered to literally for the length—it has to be adjusted for existing conditions. When engine and tender are coupled up the water hose should hang in such a manner as to make one continuous easy curve from the point of the feed pipe connection on the engine to the tank well connection. Any other form is apt to kink the hose.

Your committee concludes that in the light of the information in hand we are not justified in discarding the hose. We feel assured that with a reasonable amount of attention to this detail the present maintenance may be considerably reduced.

The report is signed by H. T. Bentley (Chairman), C. & N. W.; H. C. Oviatt, N. Y., N. H. & H.; C. E. Fuller, Union Pacific; F. H. Hardin, N. Y. C.; H. M. Curry, Northern Pacific; E. C. Chenoweth, C., R. I. & P.; M. F. Cox, L. & N.; W. I. Cantley, Lehigh Valley; G. H. Emerson, B. & O.; P. F. Smith, Jr., Penn. System; and W. H. Winterrowd, Canadian Pacific.

Discussion

H. T. Bentley (C. & N. W.): As your committee was required to handle so many subjects, I would suggest that all of the members of this committee come forward and as each of the subjects come up the chairman, or if he is not here a member of that subcommittee, can read the paper and be in a position to discuss it more satisfactorily than perhaps I might be. If that is satisfactory I will call on the committees to come forward.

I would suggest that F. H. Hardin be asked to read the paper on Tractive Power of Locomotives.

F. H. Hardin (N. Y. C.) then presented Exhibit A and at its conclusion said: I was asked a few moments ago why this paper was submitted merely for discussion. The question was raised by someone for consideration by the Committee of Locomotive Construction. In looking into the matter, these differences, of course, soon appeared and the sub-committee thought that it might be advisable to recommend to the convention a uniform formula. On canvassing the situation we found that there was more or less opposition to that on account of the fact that the rating of practically all the Mallets, (I guess all of the Mallets in the United States,) would have to be changed. For that reason no definite recommendation was made. We also made inquiries to see whether there were any actual definite tests that would indicate which of these three formulae could be considered more accurate and we were not able to obtain any information along that line. As a result the committee thought that the paper should be submitted in this manner for discussion.

Exhibit A is now before you for discussion. This is a very important subject, and I suppose it will be necessary for the chair to call on some of you gentlemen. I would like to call on Mr. Pilcher of the Norfolk & Western.

J. A. Pilcher (N. & W.): The question of the accuracy of the formula, of course, is simply a question of how close it comes to the actual performance of the locomotives. The fact that the formula is calculated one way or another will not affect the pulling power of the locomotive. I was a little struck with the fact that in making the report the committee says it would have to change the rating. The rating is going to be made on what actually happened and not on the formula. As I understand it the test is being made simply to get same method of expression of what is actually taking place on the locomotive when it is in operation. A formula is a good thing to work to, but it will require some further test to show which of these is the most accurate. I am sorry I have not the information, but probably we will be able to develop it some time in connection with some test using the dynamometer car.

C. E. Brooks (C. N.): May I ask if the same heating surface values were used in the three different formulae, including the firebox and flue heating surface values.

Mr. Hardin: The heating surface values were not taken into consideration in the formulae at all. In other words, it is a question of boiler pressure, mean effective

boiler pressure in the cylinders, cylinder diameter, stroke and diameter of drivers. It is assumed that sufficient heating surface is available to provide the steam for the locomotive being built.

G. Greenough (Baldwin Locomotive Company): In the formulae, you will notice at first glance that there is a considerable difference in the actual tractive power as obtained with the three formulae. If the differences are analyzed you will notice that the Baldwin formula, in each instance, is approximately six per cent below that of the American Locomotive Company and the I.C.C.

Analyzing the matter a little further, you notice that the Baldwin Locomotive is based upon 85 per cent of the boiler pressure as a minimum effective pressure obtained in the cylinders at full stroke, whereas both of the others are 91 per cent of over. That difference, roughly speaking, is about seven per cent or a little more, which would indicate that when you eliminate the difference of opinion as to what the mean effective pressure is in the high pressure cylinders, you practically eliminate the difference within a matter of one or two per cent in the formulae.

Consequently it becomes a question if it is advisable to assume that we obtain 91 percent of the mean effective pressure, or 85 percent, or something in between these two.

The Baldwin Locomotive Works always endeavors to retain in their formula what may be termed average conditions. I have no doubt but that in some locomotives where the steam ports and the various exits from the throttle to the cylinder are large, 91 per cent, or even more, is possible at low speeds. We hold to the opinion, however, that 85 percent more nearly represents average conditions so it seems to me there is not much to choose between the formulae, aside from that matter of mean effective pressure.

I notice that the paper is entitled "Tractive Power of Mallet Locomotives," but these formulae, as has been intimated in the paper, only deal with the tractive power of Mallet locomotives at starting or at very low speeds. I will therefore ask if it is in order for me to say a word with regard to the tractive power of locomotives as they are running?

Chairman Coleman: Certainly. This, as I understand it, is a report on the Tractive Power of Mallet Locomotives but will include all the other locomotives.

Mr. Greenough: I would like to bring to your attention the fact that for years we have given a great deal of attention to the tractive power of Mallet locomotives when starting, but very little attention to the tractive power while running.

I do not know how many of you are aware that H. V. Willey, of the Baldwin Locomotive works, recently made a study of this matter and has developed a valve-gear for bringing about or making possible a constant cut-off on the low pressure cylinders. It seems almost incredible that for years we have been operating Mallet locomotives in the present manner. We introduce steam in the high pressure cylinder; that in turn goes to the low pressure cylinder; and, as we hook the engine back and cut off the steam in the high pressure cylinder, we do the same thing with the low pressure cylinder, exhausting the steam from the low pressure cylinder into the air before it has done half its work.

The valve gear which I speak of is so designed that the low pressure cylinder does not exhaust the steam until the end of the stroke no matter how far back the high pressure cylinder may be cut off. I think this is something that is well worth considering. In the few experiments that have been made with this apparatus, a saving of from 20 to 30 percent in the coal bill has been effected.

W. F. Kiesel, Jr. (Penn.): It would be very desirable to have the committee give a formula as a basis on which hereafter we could compare compound locomotives. There is very little difference in the formulæ of the American Locomotive Company and the Baldwin Locomotive Company. The formulæ are nearly the same, except for the efficiency factor of 85 per cent in one case and 91.7 in the other. We have a simple engine formula based on 85 percent efficiency. Therefore, it would seem desirable to use the same co-efficient .85 percent. None of the three formulae give exact results; they are merely indicative of what the engine might be and as Mr. Pilcher stated, they should have no effect whatever on the road rating. I would therefore suggest that we decide on a standard formula for Mallet engines.

Chairman Coleman: The committee will take that under advisement.

H. T. Bentley (C. & N. W.): In accordance with Mr. Kiesel's suggestion I move that the committee be continued and be asked to cooperate with the three locomotive builders so that a uniform formula may be developed.

Mr. Hardin: May I suggest that the Interstate Commerce Commission be called into that also?

Mr. Bentley: I will be very glad to include that in the motion.

(*The motion was seconded, put to a vote and carried.*)

H. C. Oviatt (N. Y., N. H. & H.) then presented Exhibit B.

C. E. Fuller (U. P.): I would like to ask the members what experience they have had with the waist sheet braces riveted to the shell of the boiler, as regards cracking of the shell. The committee reports trouble in keeping the bolts tight. I would like to know whether any of the members have had trouble with the waist sheets cracking due to the angle iron of T-iron being riveted to the boiler.

S. Zwight (N. P.): We have had a great deal of trouble on various classes of engines with the waist sheets working loose both at the top of waist sheet near the boiler and also at the bottom, but we have had very little trouble from cracking of the sheet, as referred to by Mr. Fuller. In looking into the cause of the continual working loose of waist sheets, we found that it was not due to the stress brought about by the frame, but invariably on account of the motion bearer. In some cases the boxes were fastened to the bottom portions of the braces. In looking for a way of overcoming this I examined locomotives on five or six different railroads running into Chicago and found that apparently they were all experiencing about the same difficulty. They all applied braces of various kinds, some from the motion bearer up to the boiler in a rigid brace, others with a sort of a knuckle joint in it, and some tied the frame together. We made a good, heavy, draw clamp, you might call it, to go over the top of the motion bearer, coming down under the frame and shrunk it on so as to tie the whole tightly together. We have not had any trouble on that class of locomotives where we have applied these braces so that the frame will carry the strain placed on the motion bearer and rocker boxes instead of transmitting it to the boiler brace.

S. Mullinix (R. I.): My personal observation proves to me that most of our frame breakages are due to improperly fitted binders or poor maintenance work in keeping them tight and I am inclined to believe that the lateral wear has considerable to do with broken frames. I am of the opinion that the railroads, as well as the locomotive builders, have in a great measure corrected the tendency towards broken frames by using heavier frames. I think that by watching the binders to see that they fit properly and are maintained, the frame breakages will be eliminated to a very great degree.

G. W. Rink: (C. of N. J.) We have had considerable

trouble with our locomotives in connection with attaching waist sheet braces to boilers. When we used the plain angle irons we got the waist sheet extended up inside of the angle. We had trouble with cracked boiler sheets, especially on locomotives with thin shells. We later developed a standard practice of using a heavy T-iron forming a shoulder on one side for the sheet to rest against, in order to take the sheer off the bolts. We riveted these T-irons to the boiler shells and we have had wonderful success. I really believe that is the only satisfactory way for securing waist sheets to boiler shells. In the one case the vertical pressure is off center, while with the T-iron the load is practically distributed along the vertical center line of the neutral axis of the T-iron; in that way movement of the angle iron on the boiler shell which causes that cracking effect is prevented.

W. J. Tollerton (C. R. I. & P.): This question of locomotive frames is a very important one and I think that the committee's suggestion of proper design and proper maintenance will cure the matter. We had locomotives built in 1911 with 57,000 lb. tractive power and heavy Mikado type locomotives since that time with not a single frame broken. All of our difficulties with frames were in the older type of locomotives. I am satisfied it was due to improper designing at that time, and possibly to improper maintenance.

T. F. Barton (D. L. & W.): Referring to Mr. Tollerton's remarks: Our experience has been that the principal frame breaks have occurred on locomotives that were in service some time before superheaters were applied and have broken since the superheaters were applied.

C. E. Chambers (C. R. R. of N. J.): I attribute broken frames to three distinct causes. First; the engineer in designing does not allow a large enough section. Second; material sometimes is not just what it ought to be. Third; I agree with Mr. Mullinix as to a great many broken frames being caused directly by binders working loose. If a binder is properly fitted so as to have sufficient draw and is so maintained I think at least 50 percent of frame breakages will be eliminated.

W. L. Bean (N. Y. N. H. & H.): The road with which I am connected has had trouble with several classes of older engines. The breakage was so general that it became necessary to apply new frames. The distribution of breakages was so extensive over the entire frame that there was only one conclusion to be reached and that was that too little allowance had been made at the time of designing in order to meet the weight requirements. We found, in comparing the area of the sections with what is now the accepted practice, that they were from 18 to 30 percent undersize. The breakages were so great that there was an average of three failures per locomotive per year, so we have undertaken a program of reframing.

I would like to speak of one thing in connection with this matter of frames on large modern power, particularly with reference to the boiler. It is very necessary to maintain a proper distance from the front of the mud ring to the top of the frame and if that is not done the boiler, being rigid, will cause unequal loading and bending of the frame under the front of the mud ring. Many difficulties have been experienced with breakages at that point and they have been taken care of by re-establishing that dimension, and maintaining it.

C. E. Fuller (U. P.): One of the most vital points in this connection is maintaining the proper relation between the boiler and the frame. I will venture to say that a large number of shops in passing the engine through for repairs have given very little attention to the original alignment of the boiler with the frames. Especially is that true on roads whose practice it is, in applying a new firebox, to cut off the butt end and take it to the boiler shop, reapplying the butt end after the firebox has been applied.

The use of flexible bolts for supporting the firebox to the frame, has been responsible for a large number of broken frames. It is almost impossible to maintain bolts of the height required and the bolt holes will wear. The result has been that the locomotives have been passed through the shop without taking the opportunity to raise the boiler up to the proper height.

Another thing which has happened, especially where the barrel-brace connected to the guide yoke and the angle iron or T-iron is riveted to the boiler, is that unless the proper distance is maintained between the front end of the mud ring, and the throat sheet of the frames, an undue strain is put on the guide yoke brace.

After having a great many barrel sheets separated from the holes we decided that it is better to leave it loose, and start the locomotive with probably 1-32 in. beween the barrel and the front brace at the center, ⅛ in. on the front end, and run the T-iron around the boiler in one piece, rather than two. Then, by maintaining the proper height at the rear end, a great many broken frames may be avoided. Cutting off the butt end and oftentimes letting the boiler be carried where it is bolted to the cylinders, on the front yoke or guide yoke causes sprung frames or fractured frames. If the alignment of the boiler under the frame is given the attention and all of the binders are kept up there will be less frame breakage.

Mr. Bentley: The member of the committee who was to have presented Exhibit C is not present. Most of the trouble appears to have been with the lubrication of Mallet low pressure slide valves and as the method of forced lubrication seems to be coming into general use I would like to ask if any of the members operating the Mallet locomotives have used the forced-feed lubrication instead of the hydrostatic lubricator? If so, with what results?

S. Zwight (N. P.): We have used the forced-feed lubricator on Mallet locomotives but I think there are only about a dozen places where we have used them to any extent. The others are the hydrostatic lubricators. The forced-feed lubricators have given entire satisfaction. We have changed them from time to time in the way of introducing the lubrication into the valves and cylinders, as explained in this paper, but we have secured good results and have no difficulty with forced-feed lubrication. That includes the use of the forced-feed lubrication on superheated Mallet locomotives.

C. E. Chambers: I note by this report that "old man graphite" is still alive. I will agree that if you could confine the graphite to the wearing surfaces it would be a wonderful thing, but my experience with graphite is that it goes to other places where you do not want it.

Mr. Fuller presented Exhibit D, Use of Extended Piston Rods on Locomotives; Minimum Size of Piston on which they shall be applied.

C. E. Brooks: I would like to ask the chairman of the committee what the recommended difference in diameter for the extended piston rod should be;—that is, the difference between the ordinary type of piston rod and the extended piston rod? How much smaller are you recommending the extended piston rod to be?

Mr. Fuller: The roads using the extended rod say that you can use an extended rod which is ½ in. smaller than the diameter of the cylinder; in fact, the whole question depends on the extended piston rod being maintained in proper position. If you can keep the piston rod up where it belongs you can run the extended piston rod a good deal smaller, dependent upon the depth of the packing. From many of the replies to our inquiry we were led to believe that maintaining the piston rod in the center of the cylin-

der is a hard thing to do; therefore, if the piston drops down you cannot use a piston rod which is any smaller.

Mr. Brooks: There is a great variation in practice on this subject. Some roads are adopting a size of piston rod as accurate when used for the extension piston rods as they would for the main piston rods. The American Locomotive practice was originally ¼ in. less when the cylinder was new. That being the case, I do not see any reason why there should be any more difficulty or why there should be any more care taken in the alignment of the extension rods and guides than with the old type of piston.

If instead of attempting the use of large piston heads we should adopt the old practice of using a piston head considerably smaller than the diameter of the cylinder (¼ in. smaller being the practice) there should be very little difficulty in maintaining conditions that would prevent wear on the cylinder when the extended piston rod is being used.

Mr. Fuller: I tried to make myself clear. In starting out an engine with an extended piston rod, you can start with a much smaller rod and it is just as satisfactory in its operation but if you do not maintain the support at the front and back fairly central, you cannot allow the rod to be worn down without trouble.

Mr. Chambers: I am against the extended piston rod all the time. In the first place, you have two fixed points, governed by a crosshead, and the bushing governing the extension rod. They are never kept in the same position. The idea of the extension piston rod is no doubt a good one, theoretically. If the bushing was maintained, the piston would float. I never saw one that would float longer than a week or two. I do not think anyone who has had extension piston rods has failed to find pistons riding on the cylinders. As to the advantage of having the piston ¼ in. smaller than the cylinder, I would like to know what there is in that. I maintain that the nearer you keep the piston head to the size of the cylinder, the better protection you get. The extended piston rod is absolutely a failure, in my opinion, and I have observed it for fifteen years.

Mr. Brooks: I think the advantage of the ¼ in. smaller piston which Mr. Fuller mentioned is that it will float.

Mr. Chambers: It never does.

Mr. Brooks: There is some chance of floating when you have it ¼ in. smaller but there is no chance of its floating when you endeaver to do what many roads are doing and that is to put in pistons of the same size as the regular piston head, and then depending on the roundhouse men to keep them floating. It cannot be done.

Mr. Fuller: Mr. Chambers hit the keynote of the whole thing. It is my opinion that if the piston can be maintained in the central position with the extended rod, all well and good. My experience has been the same as Mr. Chambers. You cannot do it and you do not do it and the result is that the piston head is riding on the bottom of the cylinder. There are few locomotives at present, judging by the information which the committee obtained, which are still equipped with the extended piston rod. I have never had satisfactory results with an extended piston rod.

S. Zwight: I want to say a word in favor of the extended piston rod. I think it all resolves itself into a matter of the design of the carrier and maintenance of the piston rod extension. We tried several different kinds of carriers for years. The first was merely a sling, with the piston rod operating through it, which would wear very rapidly and could not be maintained centrally. Later we got an extended piston rod, practically the same except for some kind of packing to hold it in position, as in the reguler piston rod. This, like the first method, was not successful and would not maintain the piston rod centrally; the result was that the packing immediately began to blow. In cold weather we could not maintain them and then we sawed the extended piston rods off. We do not recommend the use of the extended piston rod with a cylinder less than 24 in. in diameter. We have a carrier, known as the A. L. C., with a bored guide and a shoe on the end of the piston rod, sliding in this guide. It does not require much lubricant; there is practically no wear; and I see no reason why it cannot be maintained centrally. You maintain the crosshead within the limits of the piston body, with a carrier, or without a carrier, and we try to maintain it as close to those limits as we can. We have locomotives put into heavy freight service in December 1920 and in these we had not touched the cylinder packing up to 30 days ago. I do not think that could be done without an extended piston carrier but it will depend on operating conditions. If you have a level division where locomotives work steam continuously, there is no need of having the carrier, but where you are drifting down hills without enough pressure to hold the piston up, the carrier is essential and will reduce the piston wear and the cylinder wear.

Mr. Chambers. One more reason why I do not like the extended piston rod is that you have three distinct places where you are liable to get into difficulty. These are the steam gland joint, the packing, and the cap joint.

Mr. Fuller: I would like to call the attention of the members of the third paragraph in Exhibit D. The reason I am calling that to your attention is that this is taken from the practice on our railroad. Mr. Zwight said if you have a level road you possbly would not need any extension rod. In the case of the 2-10-2 class locomotive with 29½-in. cylinders, it was necessary to keep the weight down as much as possible and we went to the Z-shaped cast steel piston. On the part of the road on which these locomotives are running the grade is about 97 feet to the mile with sharp curves, and about 40 or 50 miles of it is downhill. We bronzed the piston heads, and made as high as 112,000 miles without the piston ever being taken off in order to rebronze the head. It is a practice which has proven eminently successful. We are running all the Mallet locomotives and others of our 2-10-2 type with bronzed piston heads. If you will investigate I believe you will find this a form of construction in which you have less weight and get as good service as with any extended piston rod ever put in.

I simply call attention to this because here are the facts in connection with a service which has been going on for several years. The wear of the bronze is amazing. If anybody wants to know how these heads are bronzed, a reference to the proceedings of the association about three years ago, will give the information.

Chairman Coleman: We will now pass on to Exhibit E, Use of Solid Front End Main Rod With Bushing Instead of Keys and Two-Piece Brass. We will call on Mr. Bentley to present that part of the report.

H. T. Bentley: The committee has not received enough information up to this time to make any definite recommendations in connection with Exhibit E.

Chairman Coleman: We will proceed to Exhibit F, Tender Tank Bottom—Flange Tank Bottom Compared with Riveted Joints.

(Mr. Oviatt presented the exhibit.)

Mr. G. Greenough: You will note in the committee's report a reference to the fact that the locomotive builders are inclined to believe that the type of tank under discussion will cost a little more than the ordinary tank with the angle iron seams at the lower corners. There are two reasons for that. I notice that one or two of the roads

using the flanged bottom tanks have reported difficulties due to cracks in the corners. I would not be surprised to find that they had attempted to use too low a grade of steel in making the bottoms of those tanks. It is just as important to have a good quality of steel in the tank bottom as it is to have a good quality of steel in firebox or where any flanging takes place. Consequently, tank steel cannot be used and the ordinary grades of boiler steel may not be used in certain grades of construction, but you will need the best quality of flange steel which costs more.

As to the cost of the construction itself, we have had occasion to discuss this matter with several roads which could not understand why we charged a little more for the flange construction than for the angle iron construction, basing their opinion upon the fact that in their own shop or in some railroad shops there was no difference in the cost. The reason is that the locomotive builders are equipped with the most modern methods of building tanks held together by angle iron seams. The angle irons are punched by automatic machines; there is no laying out of rivet holes; the plates are treated likewise and the riveting is done by either hydraulic or pneumatic riveters especially designed for that work. Consequently, when you put a flange plate construction in that particular shop the cost of work on the flange tank is relatively greater than the cost of the old style construction, although, taking the matter in the abstract, the cost of building the flange construction tank is no more in any railroad shop and it is apt to be less than in some shops which are similarly equipped. Should the flange construction be determined upon, it will be necessary for not only locomotive builders but the railroads to devise methods of constructing flange bottom tanks by methods as improved as are now used for the angle iron construction.

Mr. Mullinix: We have on our road approximately 100 flange bottom locomotive tanks. We have had them in service the past 3 or 4 years and have experienced no trouble whatever. I have made personal inspection of those locomotives as they come to our shops and I never found any indication of leaking.

Chairman Coleman: If there is no further discussion, we will refer to Exhibit G, Mikado vs. Consolidation—Which is Preferable and Why?

(*Mr. Fuller read Exhibit G.*)

J. Snowden Bell: The conclusion of that report is so decidedly in favor of the Mikado type that I will not attempt to argue anything in favor of the Consolidation, although I confess I am rather prejudiced. The Baldwin Locomotive Works recently built a number of large Consolidation engines, probably the largest built, for the Western Maryland and I would like Mr. Greenough to give us just a few words relative to those engines, as to what they did and what their performance has been on the road, in a general way.

Mr. Greenough: Mr. Bell has referred to Consolidation locomotives recently built for the Western Maryland. We might also refer to Consolidation locomotives recently built for the Philadelphia & Reading, an exhibit of which is on Tennessee Avenue now. I think, however, I will have to give the laurels for the heaviest Consolidation locomotives to our competitors, the American Locomotive Company, who built, I think, a heavier engine for the Delaware & Hudson.

J. Snowden Bell: I think you are mistaken as to that, Mr. Greenough. I investigated those weights and your engines are heavier.

Mr. Greenough: Well, I was told otherwise. I wanted to be sure I was fair. However, the three sets of locomotives might be dealt with as a unit. In all three cases the locomotives have comparatively short runs; in all three cases the roads are not bound by the handicap as to the cost of the fuel that some of our western lines are. They are all roads which tap the coal regions. The roads in all cases have very firm road beds and heavy rails and they are able to carry more per wheel than the majority of roads throughout the country. Consequently these three roads are in a peculiarily happy condition as to the loads they can carry on drivers, as to the amount of coal they can use, and as to the length of runs. Taking the items wherein the Mikado locomotive outclasses the Consolidation locomotive, you will find that in these particular cases the Consolidation locomotive is built to get by, because of the peculiar conditions under which they are running. If you eliminate those conditions, there is no question at all but that the report of this committee is absolutely correct that the Mikado is superior to the Consolidation locomotive as a type, where the maximum efficiency and locomotive design is necessary to meet road conditions.

Chairman Coleman: If there is no further discussion on Exhibit G we will refer to Exhibit H, Advantages and Disadvantages of (a) Non-Lifting Injectors, (b) Lifting Injectors.

(*Mr. Bohan read Exhibit H.*)

G. W. Rink: We have had a little experience with non-lifting injectors. Our first experience came about due to the purchase of administration design locomotives. These non-lifting injectors were screwed to the locomotive frame and we had considerable trouble on switching locomotives, due to side swiping, and the dislocation of injectors due to derailments. We also had trouble with the pipe connections. Then we hit upon the scheme of securing the injectors to the mud ring of the boiler and all our troubles, as far as the pipe joints are concerned, have ceased. It also gave us an opportunity to raise the injectors on these particular low wheel locomotives.

Chairman Coleman: If there is no further discussion of Exhibit H we will refer to Exhibit I, relating to Drifting Valves.

(*Mr. Bohan read Exhibit I.*)

A. H. Fetters (U. P.): I have not had much experience with drifting valves but I sincerely believe that a drifting valve is necessary for superheated locomotives. The practice of cracking the throttle is generally used on most roads but engineers are likely to indulge in abuses of this practice. I have observed many times that the last thing an engineer does in making a station stop is to close the throttle. The result is that the cylinders are left full of steam and the pressure kept on the throttle pipe will often show as high as 160 lb. when the engine first comes to rest. That is an abuse of the locomotive which it ought not to be required to stand. Drifting with a cracked throttle would be all right if it were scientifically carried out; that is to say, if the steam were used in drifting until within a train length or two of the station, then being entirely shut off and the brake used the rest of the distance. As a rule the brakes are used too much and the steam is in the cylinders to that extent. I think that a drifting valve, to be a success on a locomotive, should be entirely automatic and it should be removed entirely from access by the enginemen or the roundhouse men. A pilot valve in the cab is likely to be overlooked; I have seen many locomotives go over the road with a drifting valve which was not operating because the pilot valve was not closed. Sometimes the valve is left open and may cause creeping which is serious and dangerous. Therefore, a drifting valve should be entirely automatic in its performance and should be so arranged that it will be as simple as possible in mechanical details and not subject to freezing. It should be reliable and always on the job.

I do not know that any such drifting valve exists at the

present time but there is a big field open for the inventive talent of the railroad men today in that line. I think ultimately something of that kind will be developed and it will be a great help on superheated locomotives.

Chairman Coleman: If there is no further discussion on this Exhibit, we will refer to Exhibit J, Tank Syphons vs. Tank Valves.

(*Mr. Bentley read Exhibit J.*)

H. H. Lanning (Santa Fe): The road with which I am connected formerly used tank syphons almost exclusively. We found two very serious drawbacks; probably the worst was this: that corrosion of the syphon pipe took place inside of the tender permitting air to leak into the syphon pipe and break the vacuum. We got along fairly well with these until we came to the non-lifting injector. The lifting injector would prime the syphon each time, overcome the air leak, and operate with a fair measure of success so long as there was a reasonable amount of water in the tank. Coming to the non-lifting injector, which had a smaller lifting power, these air leaks in the syphons caused a great deal of trouble and practically forced us to use tank syphons.

Chairman Coleman: If there is no further discussion of this Exhibit, we will refer to Exhibit K, Tank Hose vs. Metallic Conditions.

(*Mr. Bentley read Exhibit K.*)

Chairman Coleman: This is a very creditable paper. It has been discussed very thoroughly and is a credit to the committee.

(*A motion to accept the report was voted on and carried.*)

Feed Water Heaters for Locomotives

The committee finds that there are 58 feedwater heaters in service and 139 on order for locomotives on the railroads of the United States and Canada. Test data quoted show feedwater temperature rises ranging from 145 deg. to 175 deg. F. and fuel savings of from 10.5 per cent to 16.5 per cent.

The committee concludes "that it is a generally accepted fact that the use of a feedwater heater will increase the efficiency of a locomotive. There is very little complaint in regard to their maintenance, but more information on this subject and further improvements in design may be expected when feedwater heaters are applied in larger numbers, so that they are subjected to the same character of repair work and supervision as other parts of the locomotive.

"It is recommended that the work of this committee be continued and that additions be made to the rules covering locomotive tests, whereby standard methods may be introduced for testing the two types of heaters so that the results of heater tests made on different roads may be comparable."

THAT CONSIDERABLE INTEREST in the use of feed water heaters has developed during the last two years is evident from the number that have been applied. The committee's report for the year 1920 showed that there were 16 locomotives equipped at that time. There are now 186 feed water heaters in service or on order; 15 open type in service and 110 on order; 43 closed type in service and 29 on order.*

All new applications reported to the committee have been exhaust steam heaters, either of the open type, manufactured by the Worthington Company, or of the closed type, manufactured by the Superheater Company, with the exception of one, a Foster-Thompson exhaust gas heater.

*A table accompanying the report shows that 106 of the open type heaters on the order are for the Southern Pacific and 24 of the closed heaters on order are for the New York, New Haven and Hartford.

A questionnaire was again submitted to the members this year. The replies are summarized below.

Maintenance Cost

The cost of upkeep of either the open or closed type heaters as reported by the different roads varies from $1.00 to $9.00 per 1,000 locomotive miles. Such a range is to be expected, as development work is still in progress and we can not expect close agreement of the cost figures until a large number of heaters are in service and the supervision and repairs follow the general practice accorded other devices.

Tests at Inspection Pits

No railroad reports any systematic daily inspection of feed water heaters. The usual practice is to depend upon the engineer's report, and to supplement it by having the engine house inspector run the pump and note its action and any leaks in the pump or piping. Some roads report that at boiler wash periods they make a systematic inspection which includes special examinations of valves, tubes and other parts.

Piping.—Some trouble has been experienced in maintaining the joints, but some of the roads advise that, by using iron pipe, bracing it thoroughly, and keeping the number of joints to a minimum, little trouble will occur. A majority of the replies report the use of iron pipe with flanged joints.

Boiler Check.—A number of the roads reported difficulty maintaining the boiler check, but have overcome it to a certain extent by reducing the lift of the valve. Where a small valve was in use, a larger valve was applied to compensate for the reduced lift.

Freezing of Heater.—In ordinary cold weather the heat radiated from the boiler has been sufficient to prevent freezing and where proper precaution is used no trouble should result. All roads are using suitable drain cocks where necessary and in addition some of them have applied a small steam supply line to the suction pipe, which is used when the pump is not working. Both the open and closed type heaters are thoroughly lagged.

Oil Separator.—The use of oil separators with heaters seems to be general. Only two roads report having found traces of oil in the boiler, and both state that it has not resulted in any damage to the boiler. One of these roads, which is located in bad water districts, attributes an increased amount of foaming to the presence of oil in the boiler.

The other road, which is located in a good water district, reports that they have had heaters in service for several years and that frequent chemical analyses of the boiler scale have never shown more than a trace of oil, although one heater was in service for one year with the oil drain from the separator closed.

Economy Tests

A number of the roads have made economy tests of the heater in comparison with the injector, and some very excellent results

have been obtained. The committee has no information as to how these tests were run and can not vouch for the accuracy of the results reported, but give them as information.

ROAD NO. 1 — CLOSED TYPE
Increased evaporation per pound of coal.....15.3 per cent
Coal saving per 1,000 gross ton miles.....12.3 per cent
Increase in over-all boiler, furnace and grate efficiency .....14.3 per cent
Type of locomotive tested (cylinders 27 in. by 30 in., drivers 69 in., 200 lb. boiler pressure).....4-8-2

ROAD NO. 2 — OPEN TYPE
Coal saving .....12 per cent

ROAD NO. 3 — CLOSED TYPE
Increased evaporation per pound of coal.....24.1 per cent
Decrease in fuel consumption.....10.5 per cent
Decrease in superheat.....3.6 per cent

ROAD NO. 4 — OPEN TYPE
Saving in coal per 1,000 ton miles.....14.0 per cent
Increased boiler efficiency.....16.1 per cent
Exhaust steam recovered from the cylinders, condensed and returned to the boiler.....8.6 per cent
Decrease in superheat, deg. F.....21.7

ROAD NO. 5 — CLOSED TYPE
Saving in coal per 1,000 ton miles.....8.9 per cent

ROAD NO. 6 — OPEN TYPE
Saving in fuel oil.....12.5 per cent

ROAD NO. 7 — CLOSED TYPE
Saving in coal per trip.....12.5 per cent
Increased evaporation per pound of coal fired.....16.0 per cent

ROAD NO. 8 — CLOSED TYPE
Saving in fuel.....13.0 per cent

ROAD NO. 9 — CLOSED TYPE
Saving in fuel.....16.5 per cent

ROAD NO. 10 — CLOSED TYPE
Saving in fuel.....14.0 per cent

Temperature of Feed Water

The rise in temperature of the feed water is a very definite indication of the economy which is gained by the use of feed water heaters, and accordingly in the questionnaire temperatures obtained, with the locomotive working at or near maximum power and also with a light train, of the delivery water, suction water and exhaust steam, were requested in order to more fully bring out this feature. A digest of the replies shows that the rise in temperature for heavy trains ranged from 135 deg. to 185 deg. F., with an average of 156 deg. F. For light trains the rise ranged from 92 deg F., to 175 deg. F., with an average of 144 deg. Many of the roads reported but small differences in the temperatures obtained for heavy trains and for light trains.

Cleaning of the Heaters

In good water districts no trouble has been experienced with the collection of mud or scale in the heaters, but in bad water districts such has been the case and consequently it has been necessary to clean them.

With the open type the usual method has been to scrape the scale and mud loose and then wash it out with a hose. With the closed type the inside of the tubes are usually cleaned by pumping through them a solution of muriatic acid and the outside of the tubes are cleaned by boiling them in a solution of washing soda for about twenty minutes and then washing them with hot water.

Exhaust Nozzle

There was no agreement as to the necessity or the advisability of changing the size of the exhaust nozzle. Four roads found it necessary to decrease the size of the nozzle and ten have made no change at all.

Indicating Device for Pump

Pressure gauges of various types have been the only device used to indicate the action of the pump. The opinion is general that there should be some device which will tell the enginemen that the pump is running, but the results so far obtained with the gauges have not been entirely satisfactory due to their inability to stand the severe service.

Use of Heater When Locomotive Is Standing or Drifting

When the locomotive is standing or drifting the use of the heater is not recommended. Objection has been made to the application of feed water heaters on the ground that it would be impossible to prevent their use when there was no exhaust steam to heat the water and then cold water introduced into the bolier would have a bad effect on the fluses and firebox.

The replies to the questionnaire indicate that there is no evidence that the use of the feed water heater has resulted in any damage to the boiler.

The use of exhaust steam from the auxiliaries, such as air pump, headlight generator and stoker may be advisable in order to maintain the temperature of the feed water when the locomotive is not working. Several roads express the opinion that any damage from the introduction of cold water to the boiler would be reduced by the use of a top head check.

Capacity of Heater

The question with reference to the capacity of the heater developed the fact that a few of the roads were of the opinion that the capacity of the heater should be equivalent to that of one injector, while the majority desire an increased capacity ranging from 10 per cent to 100 per cent, with an average of about 33 per cent. Some additional capacity no doubt should be provided to compensate for the reduction in the capacity of the feed water heater due to worn packing, worn cylinders or leaky valves.

It is recommended that the work of this committee be continued and that additions be made to the rules covering locomotive tests, whereby standard methods may be introduced for testing the two types of heaters so that the results of heater tests made on different roads may be comparable.

The report is signed by F. M. Waring (Chairman), Penn. System; A. Kearney, N. & W.; W Kelly, Great Northern; G. W. Rink, C. R. of N. Y.; L. P. Michael, C. & N. W.; G. S. Edmonds, D. & H., and H. C. Oviatt, N. Y., N. H. & H.

Discussion

F. M. Waring (Penn.): Your committee can only report progress and submit a short summary of replies that it has received to its inquiries made to the members regarding their experience with feed water heaters.

It is interesting and encouraging to note that the table giving the number of heaters in use is already out of date, before the report is presented. We have unofficial information that the number of open heaters should be increased by about 19 and the committee will endeavor to bring that table up to date before the report is printed.

J. Snowden Bell: Inasmuch as this report shows a fuel saving from 8 and 9 to 14 percent and averaging 12.6 on nine reported cases, there can be no question but that the feed water heater is a fuel saving device. It comes directly within the suggestion of the chairman for full and careful consideration and I earnestly hope that it will be discussed. The subject is by no means a new one. Feed water heaters were introduced in this country and put in service (I saw them in 1883) as early as 1836 and from time to time since that year various designs have been experimented with and used to some extent. The Pennsylvania has about ten. There were a very large number on the Reading but for some reason they were discontinued and it is only recently that they have been revived.

We have before us two types in the open and the closed heaters. They are not half-baked experiments, or any sort of theoretical scheme, but they are well developed, actual constructions which have stood the test of use. I do not think, Mr. Chairman, that the last word has been said as to either type, nor do I think that these will be the only types. These, however, come before us with well reported success and it seems to me that they certainly ought to have a very full and careful consideration and discussion.

In preparing the paper which I presented at the 1918 meeting on feed water heaters and their development, I sent inquiries to members and there were 51 favorable to feed water heaters and 11 who either expressed doubt or were unfavorable. The very material increase in favorable sentiment since then is evidenced by the fact that in 1920 there were only 16 locomotives equipped and now 197 heaters are in service or on order.

I recently saw a design of smokebox jacket heater which impressed me very favorably for its simplicity. I have never approved of the smokebox heater and it has failed for the reason that we have got too many things in the smokebox now. We do not want anything more in there and if we take out a few of the present parts it will be

of advantage. It always seemed to me that a smokebox jacket heater would get the benefit of the heat if it could be made in a simple manner. That was the design presented. I do not know how far it has been carried out but if Mr. Giles is here he probably can tell us because it emanated from his department. It was constructed very much on the style I described in the 1918 report, regarding which the superintendent of motive power on the road that was using it said: "This heater was in use for about two years, but on account of the application of a superheater it was taken out. The arrangement showed a good saving in coal and repairs to the boiler and the water entered the boiler at a temperature of 250 deg. I am of the opinion that the device has merit both in economy in fuel and in repairs to the boiler, as the boiler has a more even temperature than when supplied by an injector."

Mr. Flory: I would like to make a suggestion that the work of this committee be extended to include an investigation of exhaust steam injectors. The exhaust steam injector, while new in this country, presents great opportunities for fuel saving, possibly as much as the feed water heater, and we should get all the information we have on that subject.

Mr. Waring: We will look into that.

(*A motion that the report be accepted and the committee continued was carried.*)

Modernization of Stationary Boiler Plants

There are two distinct types of committee work in an organization such as the Mechanical Division. One is what might be termed the legislative type, leading to the development of standards to which all are expected to adhere; the other is one of service, in which the committee labors to the end that each member of the organization may have available the fund of basic data required as a foundation on which to build his own structure.

The report of this committee is an example of a real service well rendered. It has compiled a large fund of valuable comparative data which is digested and presented in a form for convenient use as a guide in the selections of (a) the most economical type of stack construction, (b) the kind of pipe joints to be used, (c) the most economical type of prime mover, and (d) the piping arrangement and setting for horizontal return tubular boilers. These are all problems encountered either in modernizing existing power houses or in planning for new ones.

Schutz Crushed Coal Furnace

THE SCHUTZ CRUSHED coal furnace is a coal-burning device using a coal that has been finely crushed but not pulverized, and without extracting the moisture. Some progress has been made with the development of this furnace, but it is as yet not a commercial proposition. Owing to general business conditions existing since last annual report, a great deal of experimental work has not been done that would otherwise have brought this furnace to a higher stage of development.

This furnace, however, was applied to a 500 hp. boiler in a commercial power generating station, and results obtained were very favorable. However, experimenters are not ready at this time to publish their findings and are waiting also for additional development before recommending this furnace for a commercial proposition.

Chain Grate Stokers

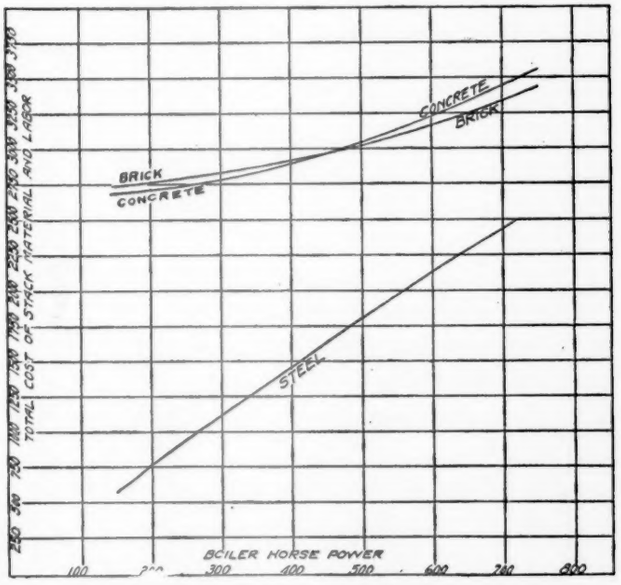
In districts where highly volatile coking coal is available, the chain grate stoker is a very popular form of coal-burning device. The coal is carried into the furnace, ignited, the combustible burned up, and the ash continuously dropped over the rear end of this stoker. This stoker operates with a minimum amount of labor and maintenance, due principally to the absence of handling clinkers and the continuous self-cleaning feature.

Over 60 per cent of all stokers west of Pittsburgh are of the chain grate type, with the exception of points where West Virginia coking coal is available. These sections are in the vicinity of Cincinnati, and also in the Wisconsin and Michigan regions.

Owing to the coking nature of coal generally found east of Pittsburgh, the chain grate type stoker has not proven very successful, probably less than 10 per cent of all stokers east of Pittsburgh being chain grate. This applies to the natural draft chain grate stoker.

In recent years there has been developed a traveling grate utilizing forced draft. While the method of feeding coal and disposing of ash is similar in this forced draft and natural draft stoker, there is a great difference in the kinds of coal that can be burned with these two stokers. The forced draft traveling grate has been very successful in burning coke brieze and certain eastern coal such as anthracite culm. There are numerous installations of this forced draft traveling grate type of stoker, which according to all reports are giving very successful results.

Owing to the low maintenance cost of this type of grate, and the minimum amount of labor required for its operation, and the fact that it provides a means of meeting fluctuating loads and burning fuels heretofore considered as waste, it has all the advantages of the natural draft chain grate stoker with very few of its disadvantages. It provides a means whereby boiler capacity can be

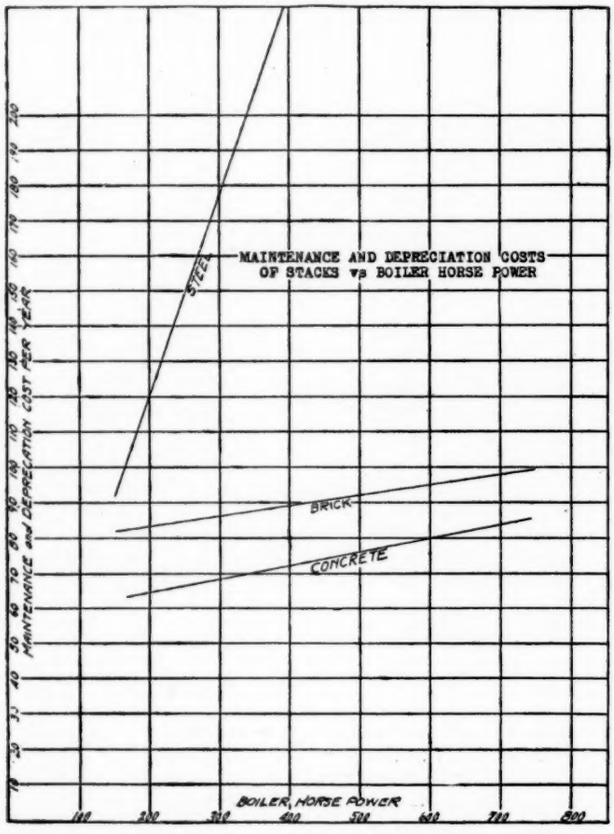


Relation of Stack Costs to Boiler Horsepower

increased without the addition of new boilers and with a minimum expenditure in adapting or changing present natural chain grates for the forced draft type of traveling grate.

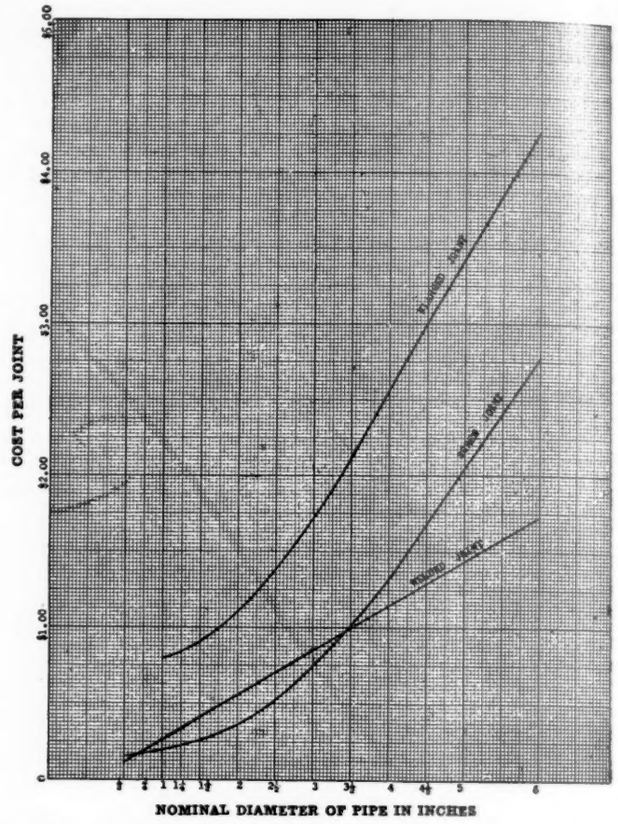
Relative Cost of Steel, Concrete and Brick Stacks

The curves of stack cost represent the average total cost taken from a number of steel, concrete and brick stack costs. While



Relation of Maintenance and Depreciation Costs of Various Types of Stacks to Boiler Horsepower

no allowance is made for a small variation in diameter and height of stack for plants of the same boiler horse-power, the result

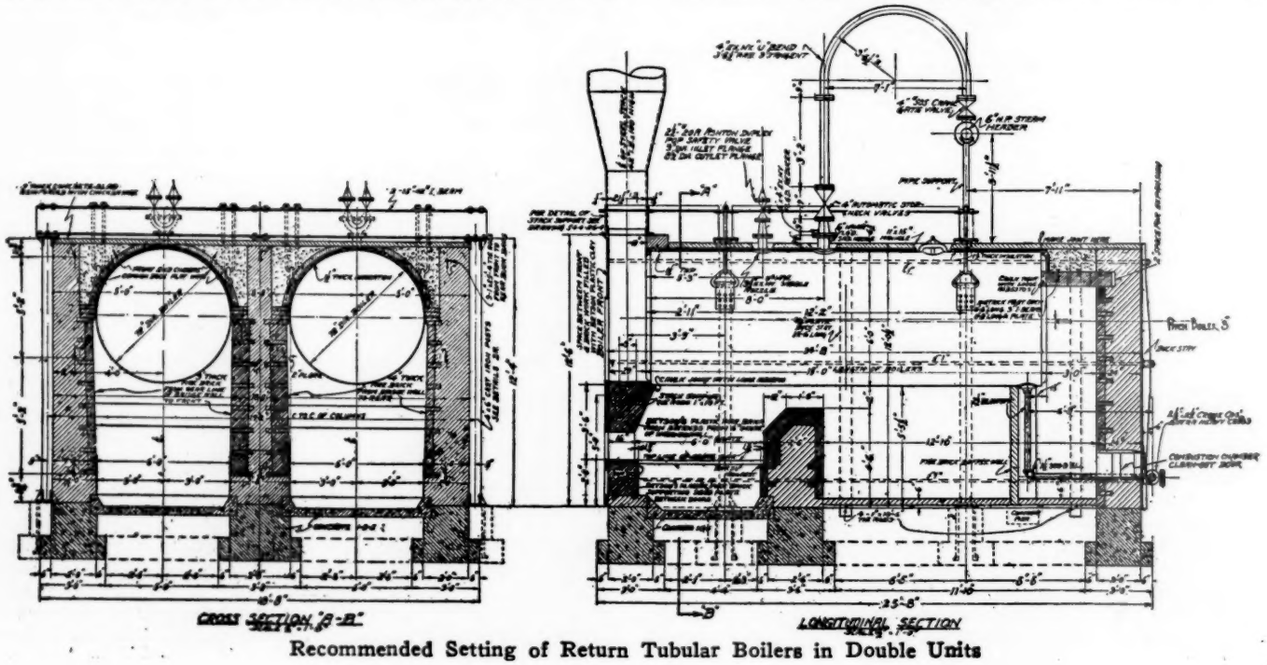


Relation of Maintenance and Depreciation Costs of Various

represents a fair comparison in the cost of stacks for plants of from 150 to 600 boiler hp. and may be considered fairly accurate.

Steel stacks increase in cost directly in proportion to the boiler horsepower of the plant, this being due to duplication of stacks for the larger plants. The cost is much lower for smaller plants, but gradually approaches the cost of concrete and brick as the size of plant increases. Concrete stacks decrease in cost per boiler horse-power as the size of the plant increases, the cost being silghtly higher than the cost of brick for the same size of plant above 500 hp. and less for plants below 500 hp

The maintenance curves are plotted on the basis of maintenance



Recommended Setting of Return Tubular Boilers in Double Units

and depreciation of 2½ per cent of total cost for concrete stacks per year, 3 per cent for brick stacks and 16 per cent for steel stacks. This, however, may be variable, depending upon local conditions, design and proper maintenance, but appears to represent a basis of comparison which is comparatively accurate. From this it is seen that the maintenance and depreciation is lowest for concrete stacks, as there is practically no appreciable upkeep to a concrete stack. Brick stacks require pointing up from time to time, while steel stacks require painting annually or biannually, with renewing of top sections frequently.

The Welding of Pipe Lines in Power Plants

The accompanying curves show cost of fitting pipes with flange fittings, screw fittings and welded joints, based on the cost per joint, which would include cutting two threads, fitting two flanges and bolts in case of the flanges fitting, or screwing and coupling in case of the screwed fittings

It will be noted that for sizes under 3½ in. the cost per joint in case of welded pipe is a little more than the cost of screwed fittings, until the smaller sizes are reached, where the two costs run about equal. For sizes 3½ in. and larger it will be noted that there is a material saving in cost in favor of welded joints. Comparing this with flange fittings, it will be noted that the saving is considerable for all sizes, averaging close to 50 per cent from 1-in. to 6-in. sizes. However, the saving is not all in the first cost of fitting, but by eliminating threaded joints much longer life and less maintenance can be expected. The weakest point of threaded pipe is at the threads so far as life is concerned. It is at this point that corrosion first takes place, which in a short time results in leakage.

Two methods of welding pipe are suggested: (1), a butt weld, in which the pipe is carefully faced on the end and in some cases scarfed, and (2), a lap weld, made by using a sleeve, similar to a coupler without threads, slipped over the joint and welded to the pipe at either end. Where the latter method is used special fittings such as "T's," "L's," etc., could be made up economically on a production basis when demand for such fittings becomes sufficiently large. When the butt weld is used great care must be taken to prevent possibility of fins forming inside and obstructing the pipes. This is eliminated where the sleeve type of weld is used and the latter also tends to give greater strength to the pipe at the weld.

No definite recommendations are made at this time for the welding of pipes, and merely a few suggestions are presented. However, the possibility of saving by use of welded instead of flanged or screwed joints is very great with the smaller size pipes, 6 in. and under, with pressures not to exceed, say, 150 lb. For power plant work where high pressure headers are used a different method of welding would have to be adopted.

In both the modernization of old stationary power plants and the design and installation of new plants, much study is required in determining the proper selection of the type of prime movers.

In late years the choice of prime movers for stationary power plants has been in favor of the reciprocating steam engine or turbine. General rules governing selections are without purpose, since each particular installation is a problem in itself. Floor space, capacity, cost of fuel, water rate, steam pressure, water supply, load characteristics, exhaust steam requirements, size of foundation, vibration, first cost, attendance, maintenance, depreciation, taxes and interest on the investment, all govern the selection of type. The principal factor governing the size of units is the station load curves; where these curves are known, the problem is a comparatively simple one, but when they must be assumed, as is generally the case with a new project, it is largely a matter of experience.

Recent developments in the perfection of the uniflow engine have resulted in remarkably low guaranteed water rates being offered by engine builders. This, with the mechanical efficiency of this type of engine being higher than other types of reciprocating engines, owing to the absence of complicated valve gears, has made the uniflow engine, running non-condensing or condensing, show superior economy over the turbine for sizes up to 600 kw.

In a general sense the piston engine is superior to the turbine for variable speed, slow rotative speeds and heavy starting torque; while the turbine has superseded the engine for large central station units and for auxiliaries requiring high rotative speed. The high-speed turbine, in connection with efficient reduction gearing, has many advantages over the piston engine for low-speed drives and is rapidly replacing the latter in this connection. Compared with other prime movers, steam turbines have the following principal advantages: Low first cost, less floor space, lighter foundations and less attendance, better utilization of high vacuum and lower oil consumption, no reciprocating masses with their resulting vibrations, no rubbing parts outside of the bearings; they have extreme overload capacity, and freedom of the exhaust steam from oil, increased reliability due to simplicity of construction; excellent regulation and with favorable conditions as regards steam pressure, superheat and vacuum, economies as good as steam engines for moderate powers and much better economies for units of larger sizes.

A general comparison of the water rates of piston engines and steam turbines is very unsatisfactory because of the wide range in operating conditions. In a general sense, the piston engine is more economical in the use of steam than the turbine for non-condensing service and the reverse is true for high pressure, high-vacuum condensing service. Condensing engines of the uniflow or poppet-valve type have shown superior economy (under favorable conditions) to the turbines for sizes up to 3,000 hp. and, in some instances, up to 5,000 hp., but heat economy is only one of the many factors entering into the ultimate cost of power. For sizes over 3,000 hp. the turbine is in a class of its own.

The most efficient types and sizes of turbines are the impulse type for very small units, the reaction or impulse reaction type for medium and large size units and the reaction type for units of very large sizes.

Tables showing water rates of reciprocating steam engines and turbines at variable loads and conditions are given below. It should be remembered when referring to these tables that the water rates given do not hold good for all operating conditions. Water rates vary with superheat or moisture, and back pressure; therefore, no comparison of water rate alone can be fair, unless the steam conditions are known.

Table I gives the steam consumption per horse-power per hour which may be expected from various types of engines with different steam pressures, running at most economical load. The figures are believed to be fairly accurate in a relative sense.

TABLE I—STEAM CONSUMPTION OF DIFFERENT TYPES OF ENGINES

Type of Engine	Lb. of steam per hp. per hour	Steam pressure, lb. gage
High-speed simple non-condensing.....	32	80-100
High-speed compound non-condensing..	24 26	150-110
High-speed compound condensing.....	19-21	150-110
Corliss simple non-condensing.....	26	80-100
Corliss simple condensing.....	21	80-100
Corliss compound non-condensing.....	20-22	150-110
Corliss compound condensing.....	14-15	150-125
Triple-expansion condensing.....	13	150-

Table II gives guaranteed performances of uniflow engines offered by various well-known engine builders.

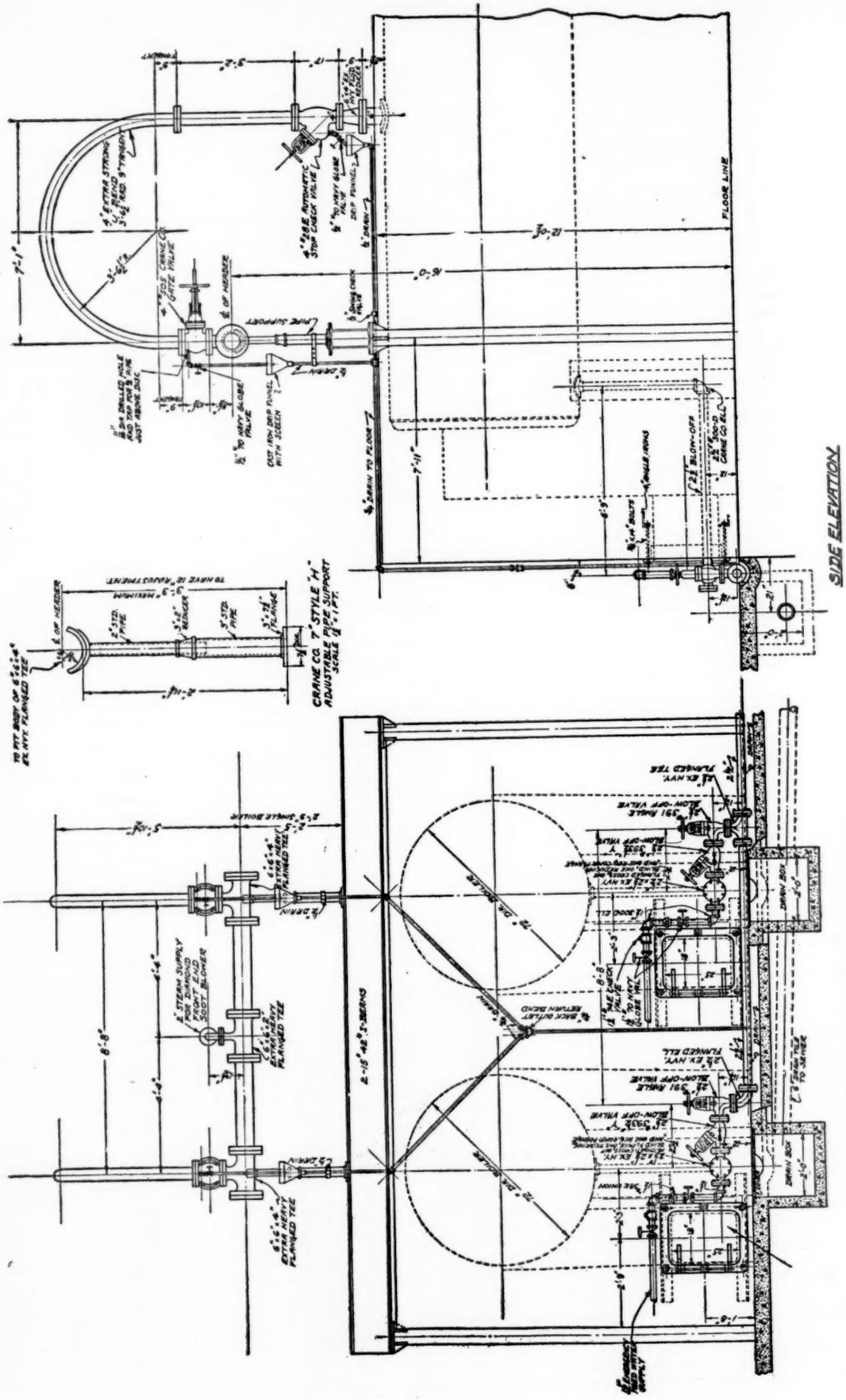
TABLE II—WATER RATES OF UNIFLOW ENGINES AT VARIABLE LOADS

Rated Capacity	R.P.M.	Initial Pressure lb. abs.	Back Pressure lb. or vacuum in.	Superheat, deg. F.	Lb. steam per 1 hp. per cent load. 25	50	75	100	125
150 k.v.a.	257	110	2 lb.	0	22.5	21.9	21.5	21.7	22.1
150 k.v.a.	257	110	2 lb.	0	21.6	20.8	20.6	21.1	....
150 k.v.a.	225	110	2 lb.	0	24.8	22.4	21.8	21.9	....
150 k.v.a.	225	110	2 lb.	0	23.9	23.2	22.8	22.6	....
200 kw.	150	200	1.25 lb.	0	....	....	....	18.5	19.1
250 kw.	....	140	1 lb.	0	18.6	18.4	18.3	18.8	....
250 kw.	....	140	26 in. vac.	0	13.6	13.5	13.7	13.8	....
400 kw.	200	200	1.25 lb.	0	....	....	....	19.7	20.3
525 kw.	....	150	2 lb.	0	....	....	....	19	....
525 kw.	....	150	26 in. vac.	0	....	....	....	14.1	....
525 kw.	....	150	26 in. vac.	150	....	....	....	11.2	....

Table III gives approximately the limitations of water rates that can be expected for turbo-generators. The better figure is probably the best that can be obtained in general practice.

TABLE III—WATER RATES OF TURBO-GENERATORS

Condensing: Steam at 150 lb. gage, 28 in. vacuum		Condensing: Steam at 200 lb. gage, 150 deg. superheat, vacuum		Noncondensing: Steam at 150 lb. gage, exhaust to atmosphere	
Rating kw.	Water rate, lb. per hr. per kw. incl. excitation	Rating kw.	Water rates, lb. per hr. per kw. incl. excitation	Rating kw.	Water rate, lb per hr. per kw.
50	32.0 to 42.0	4,000	12.0 to 13.3	50	52.0 to 60
100	21.2 to 27.5	5,000	11.9 to 13.0	100	43.5 to 50
200	19.5 to 25.0	7,500	11.6 to 12.6	200	38.4 to 44
300	18.7 to 22.3	10,000	11.2 to 12.3	300	36.5 to 42
400	18.2 to 21.0	12,500	11.1 to 12.0	400	35.2 to 40
500	17.7 to 19.3	15,000	11.1 to 11.8	500	34.1 to 38
600	17.4 to 19.0	17,500	11.0 to 11.6	600	33.4 to 37
750	17.0 to 18.8	20,000	11.0 to 11.4	750	32.7 to 36
1,000	16.5 to 18.6	25,000	10.9 to 11.3	1,000	31.7 to 35
1,250	16.2 to 18.3	30,000	10.8 to 11.2	1,250	31.0 to 34
1,500	16.0 to 18.0	35,000	10.7 to 11.1	1,500	30.7 to 33
2,000	15.7 to 17.7	40,000	10.5 to 11.1	2,000	30.1 to 32
2,500	15.5 to 17.4	50,000	10.5 to 11.0	2,500	29.4 to 31
3,000	15.4 to 17.1	60,000	10.5 to 10.9	3,000	28.9 to 30
3,500	15.3 to 16.9	75,000	10.4 to 10.8	3,500	28.6 to 29


SIDE ELEVATION
REAR ELEVATION OF BATTERY OF BOILERS
SHOWING BLOW-OFF PIPING
SCALE ⅜" = 1 FT.
CRANE CO. 7" STYLE "H" ADJUSTABLE PIPE SUPPORT
SCALE ½" = 1 FT.
FLOOR LINE
2-15'-4½" x 3'-0" DRUMS
72" DIA. SHELLS
BACK OUTLET RETURN BEND
STEAM SUPPLY FOR BLOWER FRONT END SOOT BLOWER
EXTRA HEAVY FLANGED TEE
EXTRA HEAVY FLANGED ELL
BLOW-OFF VALVE
DRAIN BOX
SEAMLESS STEEL BOILER TUBES

General Layout of Piping for Return Tubular Boiler Installation

The information outlined above should be used as a general guide in the redesign of an old plant, or in the construction of a new one; however, it should be remembered that the water rates given are subject to continual improvement.

Settings for Stationary Boilers

At this time we are confining recommendations to H. R. T. type of boilers only, because water tube boilers usually require a different setting with each installation, and in the majority of cases are stoker fired.

The drawings show a recommended practice for the setting of return tubular boilers in double units. This setting shows a distance of 42 in. from the grates to the lowest heating surface of the boiler, which should be considered a minimum rather than a maximum, particularly with middle western coal.

The additional features to be recommended for this class of setting are that the boilers are suspended from the steel work, and set so that all columns are well outside of the brick work. This eliminates the trouble usually incurred with burnt out columns when columns are inserted between settings. The flat suspended type of arch is proving very satisfactory for rear arch with this type of setting.

Particular attention should be drawn to the drains on the non-return stop valve and header valve shown in the piping drawings. These valves are in full view of the operator and in compliance with the A. S. M. E. Boiler Code requirements.

It is of particular importance when setting return tubular boilers to make the boiler independent structurally from the brick work, and make stack independent from either boiler or brick work. This results in longer life of brick setting, better alignment of boilers and better opportunity for maintenance and repair work without undue expense and disturbing of such sections as are in good condition for the purpose of repairing sections in need of attention.

The report is signed by L. A. Richardson (Chairman), C. R. I. & P.; J. V. B. Duer, Penn. System; J. H. Davis, B. & O.; L. C. Bowes, C. R. I. & P.; J. F. Raps, Illinois Central, and D. W. Cross, Toledo, St. Louis & Western.

Discussion

Mr. Bohan: I have read this paper with a good deal of interest and I would like to make a few comments on the general situation. Probably there is no facility on railroads which has generally received less engineering attention than the stationary boiler plant. From the pump boiler at the outlying water station to the shop plant, the generation of steam has been too generally considered an expedient rather than a scientific business, the economical conducting of which means dollars and cents in the treasury.

The kind of boilers and other appliances and their installation has been left too much to the other fellow who either had equipment for sale, who was looking at the original cost, or who perhaps had an old locomotive boiler he did not know what to do with. Too little fundamental analysis has been made to determine the conditions to be met and the kind of a plant that would most economically meet them. Further, original mistakes have been augmented in many instances by too little attention to the selection of the men to operate the plants and their supervision. The result is that we now have many poorly designed, inefficient plants, badly maintained and wastefully operated. There are, of course, exceptions and numbers of plants exist which were installed in accordance with the best engineering practices of the time and which are operated as economically as possible. The rapid and material improvement in stationary plant equipment and its installation and operation has, however, made many of these plants obsolete.

Unfortunately, too little is done except under immediate economic stress and we are now confronted with the question of modernization of stationary boiler plants. The subject of modernization is one that should receive most careful consideration, particularly as to installing new equipment or the application of new appliances to existing equipment.

To what extent is the addition of new appliances or changes to old plants justified and what should they be? When should old plants be scrapped and new ones provided and what kind of plants should be provided? There is no hard and fast rule and no "standard" or "recommended practice" that can be universally applied either to the design of the plant, the equipment used, or its installation. Each case requires its particular analysis and solution.

No expenditure is justified that will not result in increased betterment and returns over the existing condition. No wasteful operation is justified where it can be remedied by improved facilities or practices except as a temporary expedient in such instances as lack of funds or proper labor supply.

Assuming that funds are available, in considering the modernization of a stationary boiler plant such questions as the following should be conclusively answered:

1. What kind of service is demanded? Will it be of one kind, such as the generating of electric current, or will it be mixed, including generation of electric current, operation of air compressors, pumps, steam heating, and the like? Will any part or all of the service be intermittent or continuous during specific periods? What will be the minimum, maximum and average demands of the different kinds of service and the totals of each? A careful check and tests will be required to answer these questions.

2. What kind of a plant is at present installed? Is it of sufficient capacity? What is its condition? Is it maintained and operated as economically as possible? What does it cost to produce a horse power? What kind of fuel is used and what kind is available? What kind of labor is used and what is available? To what extent, considering the capacity and the service demand, should the plant be modernized? Is it mechanically practical to modernize the plant to the desired extent? What will it cost? What can power be produced for in the modernized plant? Can any or all of the service demands be supplied by Public Utilities and at what cost? Frequently such service can be supplied at lower cost than it can be produced for by the railway. Will the decreased cost of power production with the modernization justify the expenditure necessary?

The design of the plant, the kind and capacity of the boiler units and auxiliaries, whether water tube or return tubular and the installation, depend upon the character and importance of the service, minimum, maximum and average capacity demand, available fuel and water supply, labor supply, etc. As previously stated, there is no design that will meet all conditions. The best engineering both mechanical and electrical are necessary and well worth while.

There is one suggestion I would like to make in connection with boiler plant operation in the interest of economy and service: That the control of the personnel of power plant employees and their supervision be removed from the authority of local officers and placed in the hands of one qualified supervisor provided with the necessary corps of inspectors to enforce proper maintenance and operation of boiler plants, believing that by this means only can proper economies be effected.

E. R. Breaker (S. A. & A. P.): I want to speak a word in regard to the small shop or small terminal. The small shop is our problem and we have got to meet the question of reduction in shop fuel and to meet it without spending very much money. The small terminal of the large railroad has a similar problem to meet. They cannot afford to spend as much money on small terminals but there is an investigation which can be

made for very little expense and with very little trouble which oftentimes pays a big return on the investment.

I commenced to look into that in our own particular shop about 60 days ago, and in making the investigation I first listed the various uses which we were making of steam and then conducted some tests to see, first, how efficient our boiler plant was, and, second, just what we were doing with the steam after we had generated it. I found, that the boiler plant, which was a water tubular boiler, was fairly efficient, but I found a big loss by radiation and evaporation. Relative to the radiation leakage from the steam line, I found that on account of the fact that that loss was going on for tweney-four hours in the day, that we were losing something like forty per cent of the total steam generated by the radiation from the steam lines and the loss through leakage, most of which were not leaks of any considerable moment, but were small leaks at various joints and connections which would be passed up, generally, in the operation of the plant; large leaks were being taken care of as they developed. I found that the roundhouse, for which we furnished steam 24 hours a day, consumed about 12 per cent. The roundhouse operation for getting out about 12 locomotives in the 24 hours, was scattered all through the 24 hours—together with the radiation losses and leakage through the valves this amounted to practically 50 per cent of the total steam used in the shops which includes small shops and car shops in addition. The air compressor used about 20 per cent of the total and the stationary engine and the tie treating plant, for which we furnished steam, about 25 per cent; small miscellaneous, about 8 per cent.

The big item is the reduction of roundhouse consumption. In small terminals where we have to get engines hot throughout the twenty-four hours, it has been assumed that we must have a steam plant, but in casting around for a way to avoid that, in our particular case, I have found a simple remedy. I can shut down the shop plant at the end of the 24 hours and save this loss 16 hours out of the 24, cutting the 50 per cent loss down to about 16 per cent from that cause.

Our plant is probably no better or worse than the general small plant. It grew up with the needs of the service and was not particularly designed as to the lay-out of the piping and I find that condition existing among most small terminals. I believe, by looking into that question, we can cut down the length of pipe lines and number of connections thereby materially reduce our losses.

I have found in investigating the air lines that probably every joint and every cock has a certain amount of leakage. These leaks are not always noticeable. They are not strong enough to hear and you cannot always see them, but by testing you will find that a cock which seems to be all right by the ordinary test is leaking 3 or 4 cu. ft. of air per min. If we can weld the joints of these pipes and reduce the number of openings to a minimum, I think we will solve that problem.

C. B. Smith (B. & M.): I notice on the figure dealing with horizontal return tubular boilers that they indicate a flush front setting. The original horizontal return tubular boilers used to be set with a flush front and for 15 years or more it has been our practice in the east to set boilers with overhanging front due to the trouble of burning out the dry sheet. I would like to ask, and it may be of interest to others, the reasons why the committee has shown the flush front and what provision is made for preventing the burning out of the dry sheet. From the experience of the committee and the roads which have been using that method, I suppose there is an advantage in having a clear head room over the fire door.

Mr. Richardson: In answer to the gentleman's question, it has been our experience on the Rock Island that by using plastic brick work up to the arch over the dry sheet on the front we get excellent results and eliminate the burning out of the dry sheet. I do not think we have had a dry sheet burn out in the last six years. We find, however, that it is absolutely necessary to maintain all this plastic fire brick work in good condition and that the furnace lining should be maintained in good condition. I think our practice in the past has been to neglect the furnace linings until they got into such shape that they required expensive rebuilding. We do not have to rebuild a lining any more on our road because we maintain and perpetuate them by catching bad spots before they go too far.

G. W. Rink (C. of N. J.): I would like to make a few remarks in connection with B. & W. water tube boilers. Some members may have such boilers in their power houses and perhaps also the Rony stokers as we do, utilizing buckwheat No. 1 coal for developing steam. We were not getting the full capacity of our B. & W. boilers, due to the fact that the openings in the grate were not sufficiently large to admit sufficient air for perfect combustion. I think that is common with Rony stokers in general and we recently changed our patterns, cutting out the sides of the grate fingers in that way increasing the openings from 9 to about 18 per cent. It is surprising how much better combustion we then got within the firebox.

We have also found that our baffle walls, as a rule on B & W boilers, are not in good condition, resulting in high stack temperatures, as high as 750 degrees. After the baffle walls were repaired the temperatures dropped to about 550 degrees at the outlet of the stack. In the B. & W. boilers the baffle wall above the bridge wall runs at right angles to the tubes and also the baffle wall below the flame wall runs at right angles to the tubes. We find by taking out the baffle wall above the bridge wall and inclining it, the result is to restrict the opening on top to about 70 per cent of the grate area and as a result we get any desired flame through that pass. Also by restricting the opening at the bottom of the flame wall we get a great reduction in temperature.

Changes of that character provide for fuel economy in the power house, which is also obtained by the elimination of cracks in the walls. In the case of the bridge wall we make use of American fire brick and low temperature cement. We do not use the loose brick generally furnished for that purpose.

I might also add, in connection with steam piping, I also prefer the Van Stone type joint, either with the threaded flange, or even the solid flange, because it gives a chance to line up the pipes. We have never had any trouble in the way of leakage in any of our plants when we used corrugated copper gaskets all the way through.

In the case of steam and exhaust pipe which has been in service since 1913 we have never had occasion to repair the joint.

It is sometimes a difficult problem to get rid of the ashes, especially where they have to be hauled out by hand. We have introduced at one of our plants, where we have about 2.000 horsepower, a steam jet ash-handling system which gives entire satisfaction. Recent figures indicate that our two separate ash handling systems working 5 hours out of 24 hours, have a steam consumption of approximately 3000 lb. per hour. We simply have a pit in front of the boilers, the ashes being pulled ont and delivered by a steam jet to an overhead storage tank. When the tank is full it is unloaded into cinder cars outside.

Mr. Giles: I move that the subject be closed, the report be received and the committee continued to handle this subject during the coming year.

(The motion was duly seconded, put to a vote and carried.) *(The meeting then adjourned.)*

Section VI—Purchases and Stores—American Railway Ass'n

Interesting Paper by M. J. Wise; Committee Reports Reclamation of Material, Scrap Classification, Inventories, Material Accounting, etc.

CHAIRMAN H. B. RAY called the meeting to order at 9.30 a. m.

After formally opening the meeting, Chairman Ray retired from the chair in favor of O. V. Daniels, Assistant General Storekeeper on the Pennsylvania, who introduced his honor, Mayor Edwin F. Bader of Atlantic City. Mayor Bader welcomed Division VI to the city and complimented the members by stating that of all the conventions that came to Atlantic City, this is the best.

Response to the mayor was made by Mr. U. K. Hall, General Supervisor of Stores on the Union Pacific System.

U. K. Hall: We have met here for a very serious and definite purpose. Mr. Lee brought to us yesterday morning some figures that showed to the very largest extent the responsibility that rests upon the members.

After a brief response by Mayor Bader the chair was again taken by Mr. Ray who introduced M. J. Wise, Manager of the Dept. of Materials and Supplies, Division of Liquidation of Claims, U. S. R. A. who read the following paper:

Proper Organization in Service of Supply Real Basis for Successful Achievement

By MARION J. WISE

Manager, Department of Material and Supplies, United States Railroad Administration

MY work for the past two years has brought me more or less closely in touch with the activities of most of your individual members as well as, in a general way, the work you have been doing collectively as Division VI of the American Railway Association, and in this way I have acquired a rather clear insight as to your aims, difficulties and successes. The difficulties you have had to encounter, at times, have seemed almost insurmountable. Some of them have been overcome. There are, however, others of a most difficult nature still ahead of you, but with the courage that has characterized your past performances, I feel sure you will continue to push forward until you have reached that goal of recognition to which the service of supply is entitled.

My study of service of supply constantly brings to me the realization that an important basis factor for its highest achievement is organization. Having this strong conviction, I will endeavor to plainly give you my viewpoint with respect thereto, as well as other phases of its functions on our modern day railroads that may be closely related to the main subject.

While organization is the systematic union of individuals in a body whose officers, agents and members work together for a common end, the character of such organization for religious, political, governmental, economical, social or commercial purposes has for the ages been a most absorbing topic of study. The ravages of time and changed conditions have allowed none created for the purposes named above to preserve their original form. Those which have survived are the ones having a worthy aim, a strong personnel and proper esprit de corps. It takes but little study of the pages of history to convince any one that proper organizations for the purposes described above are the foundation of progress in the various lines of human endeavor. It would seem to follow that this foundation, to be enduring and productive of the most good should be built on the solid rock of sound experience, and not the shifting sands of unproven theory. This does not mean, however, that any organization should be "hide bound" and not venture from the trodden path, because progress means a going ahead, and going ahead means a leaving behind. Cautious progress may set a foot forward but to draw back and try another route. If no foot is raised, however, for a step on the new way, excessive caution is holding the foot still, and a standing object is more easily toppled over than one moving forward.

Fundamental Principles of Good Organization

There are certain fundamental principles governing all movements that cannot be ignored with impunity, and these fundamental principles have been and must be established irrevocably by the teachings of experience.

Railroad operation is the production of transportation and the highest aim of its organization should be to safely handle

freight and passengers between more or less widely separated points with the greatest possible despatch at the lowest possible cost.

The service of supply is an integral part of this organization and to function with proper effectiveness must have a complete organization of its own, synchronizing with all the other parts.

When the responsibility as to operating expenses of the service of supply department is seriously considered and the fact that it is in charge of 35 to 40 per cent of such cost is given due weight, its importance should be at once proven. The value of a completely organized and adequate department of this kind has been rated too low in the past, and still is in some quarters. This is largely responsible for railway operation falling short of a higher achievement.

This bare statement, however, without amplification, would be misleading. There are some railroad companies that have placed face value on their service of supply and are earning commensurate returns therefrom. There are others, who, seeing only through a glass darkly, have partially viewed the economical results that could be obtained, given only mediocre recognition to the importance of this branch of their service, and are, therefore, securing only partial returns. There are still others which have failed to take even a faltering step forward, and this class is suffering from a lack of efficiency that is adversely affecting their balance sheet in a most pronounced way.

The Human Factor

Organization is primarily concerned with human factors. Let us then consider whether organization is really vital in economic operation, or are its component parts merely conductors of currents, i. e., are the members of the organization only mediums through which instructions are carried out, or is there not some dynamic force in and of itself which should emanate from them that is of the highest importance. While it occupies no place on a railroad company's balance sheet, it cannot be successfully denied that organization has a value in proportion to the channel into which its activities are diverted. That value cannot be accurately gaged in dollars and cents and yet it does have a bearing on the real value of the property as a going concern.

The importance of the personnel of a railroad's operating force is being recognized more clearly every day and is as essentially a factor in its successes or failure as its financial status, the character and volume of its traffic, its plant and its operating rules and policies. If this were not so, then why the campaigns for safety, prevention of loss and damage, heavier loading of equipment, fuel economy and reclamation and saving of material, all of which must fundamentally base their success or failure on the interest of the personnel of the organization? Is it a real live asset or is it an unrecognized liability? There can be no satisfactory middle ground. It must be one or the other. It seems essential that the head of each operating organization should have the courage fearlessly to study and face the situation on his own road, and if his service of supply department is not organized to produce the most effective results that can be obtained, at least honestly admit it to himself and take the necessary action.

Passing from the broader phases of organization to a more concrete study as affecting service of supply, I present for your careful thought the statement,—that performance of an organization is based, first, on its personnel and form or character; second, upon the facilities with which it has to work; third, upon the methods and practices it employs. If this statement is fundamentally sound, and I believe it is, then it may be helpful to discuss its component parts with a view of attempting to apply our best judgment to what constitutes the essentials in each and the co-ordination of all of them into a composite whole for the production of the most efficient results.

Personnel

With this end in view, let us first take up the subject of personnel.

Upon the purchasing agent and the general storekeeper rests the major responsibility of the proper functioning of the service of supply and as they are the heads of the two branches of this part of the operating organization, we may use them as types. They should be models in their respective departments, for every officer and employe therein. Under our form of government, as every American citizen that is born is a potential President of the United States, so under present operation of railroads every employ is a potential head of the department in which he serves, and as a natural corollary is a potential president of a railroad. If, therefore, we consider the degree of worth of the purchasing agent and general storekeeper to the operating organization, we at the same time in substance, apply like principles to each officer and employe under them.

Their value, as individuals, in the operation of service of supply, would seem to be dependent upon the following chief personal attributes in the following roder:

(a) Intelligence, integrity and industry.
(b) Experience, courage and initiative.

I direct your particular attention to the three qualifications under heading "a," which I designate the three "I's." In every line of endeavor they stand out preeminently as essential characteristics for successful accomplishment. Any two of them linked together, without the other, no matter in what order arranged, fail to meet the full requirements for proper handling of duties connected with the service of supply. I commend to your especial consideration and thought these qualities in the personnel of your organization and I am sure if you will select, as well as train the men you now have, primarily thereon, you will eventually have an organization whose possibilities for effectual service are without limit. I am not unmindful of the difficulties surrounding the improvement of the personnel. It is a hard, laborious task and the peak of perfection can perhaps never be reached. This very fact, however, is an incentive to the man of intelligence, integrity and industry and the degre in which he accomplishes results is the barometer of his executive ability.

Experience, Courage and Initiative

We next come to experience, courage, and initiative. A great deal could be said about each one, but I will touch only the high spots of their value in the personnel of the service of supply department.

While experience in an executive is not absolutely essential, lack of it is a handicap,—not insurmountable, but difficult to overcome. There are positions, however, in service of supply where experience is an essential of the highest importance. We all know that the service of supply department has too many men in it fitted by neither experience nor training for the positions they hold. It is too often made the recipient of employes from other departments who are no more fitted for their positions than a non-railroad employe. The service of supply department is as essentially technical in its requirements as any other department of a railroad, but lack or faulty knowledge of its importance has led many executives to foist upon it for one reason or another inexperienced men, some of whom could never be properly fitted for the positions and others whe were costly experiments during the time they were learning.

Courage is an often abused word and as often misapplied. The angle from which I desire to view it as used in this connection is that of conviction. Our opinions are our own,—no can take them from us, but it would be interesting to know how many officers and employes when asked for an opinion courageously voice their own convictions and how many hold them to the model they think their executive officers want. It is but natural to try and express an opinion that will fit in with a superior's view of the same thing and it is, therefore, all the more necessary to watch carefully that we be true to our own ideas and have the courage to express them. However, when that is done to the best of our ability, our responsibility ceases and if superior authority does not agree and instructs that the matter be handled contrary to our views, as good soldiers we should carry out our instructions. The man of honest conviction, however, who has the courage to express his own opinion can not help but inspire respect and has a quality that makes him valuable. This particular quality has done as much as any one thing to place some service of supply departments in the position they now occupy on their roads because the heads of that department had the courage continually and convincingly to present to their executive officers the necessities and importance of service of supply.

Initiative has had as much to do with the development of American railroads to their present standard as any one thing, and there is equally as much of it in the personnel of service of supply as any other branch of the service. That the results have not been fully developed as in some other branches is due not

to lack of it in the individual members compared with other departments, but because organized service of supply is younger and its limitations have been more circumscribed by lack of recognition of its importance by executive officers. The accomplishments of this body within the last few years as a testimonial of no mean importance to this quality of its members. Yet, have we developed it as far as we might and have we instilled it into the rank and file in such a way as would improve our organizations? I think all will agree there is room for considerable improvement in this connection.

Let us now pass on to the form or character of reorganization. In discussing this phase of the question I am not unmindful of the fact that there are many divergent views with respect thereto.

Lack of Supervision

One of the points that stands out with extreme clearness in considering the organization of the service of supply department is the fact that it has been and still is, lacking in supervision. Did you ever stop to consider that it is responsible for 35 to 40 per cent of the operating expenses; that at all times it is responsible for material on hand representing approximately two-and-a-half times as much cash as there is in the treasuries of the railroads and measured by this responsibility the amount spent for supervision is not greater than one-sixth and often less than the amount spent for supervision in any other department? Has not the dollar spent for materials and supplies and tied up in them as many cents as the dollar spent for anything else, and if there is any merit in the generally accepted theory, and I for one believe there is great merit in it, that proper supervision is an important factor in securing satisfactory results, then it would seem not only logical but necessary, that a greater appreciation of this be extended the service of supply department.

It seems a natural sequence that this department on the large systems should have as its head an executive officer devoting his time exclusively thereto, with the heads of the immediate purchasing and stores departments reporting to him direct. It seems to me fundamentally wrong that either department should report to the other except in an advisory way, or that either or both of them should report to any other than an executive who could co-ordinate their respective activities. I cannot reconcile myself to seeing anything but a fundamental error in an organization for a large system where the purchaser of material has charge of its distribution and use or the user or distributor of material has charge of its purchase.

On smaller systems the heads of the Purchasing and Stores Department should report to the executive officer having charge of general operations.

Organization—Purchasing Department

The purchasing agent should have absolute charge of the purchase and sale of all material of every kind on a railroad. In addition to a well organized office force consisting of a full complement of experienced clerks for their particular duties, the purchasing agent should have directly assisting him, experts in the purchasing of steel, coal, lumber, cross ties and stationery where the size of the railroad is such as to justify it. If the purchasing agent is qualified for his position, no one can purchase material to better advantage than he; his value is discounted when he is not the ultimate authority on all matters involving the purchase and sale of material. If he is unfitted for the place, he should be relieved as proper results cannot be obtained by divided responsibility for the purchase of materials and supplies.

Organization—Stores Department

The general storekeeper should have charge of the handling and distribution of material and, under the supervision of the Accounting Department, the accounting for all unapplied and scrap material. A wide range of observation has given me a very decided opinion that all primary accounting for material should be under the jurisdiction of the stores department, subject only to the general supervision and check of the accounting department. Experience and operating conditions seen to make this branch of the service better fitted than any other to account for this phase of operation, just as the agency forces are best fitted for the accounting of freight and passenger business. There should, however, be the same close supervision and check of the accounting department made of the storehouse department records as is made on other departments.

The general storekeeper should have in his organization, where the size of the road justifies, sufficient traveling storekeepers to keep him in touch with the physical conditions at all major material distributing points. In addition, he should have a full complement of division storekeepers and district storekeepers so that the distribution and accounting for all material shall actually be under the jurisdiction of the stores department.

In the co-ordination of the two branches, there should be the widest exchange of views, reports and conditions, and it is in my opinion, essential in order to secure the best results, that the purchasing agent and general storekeeper should, in conjunction with the heads of other departments, make more frequent trips over the road. It is sad but true that there are some general storekeepers, and especially purchasing agents, who know less of the physical conditions surrounding the material that is under their charges than the heads of other departments. When inspection trips are made over the road, it is as necessary that the purchasing agent and general storekeeper accompany the executive officer as it is for the Chief Engineer and Superintendent of Motive Power to make it a complete success. The purchaser and distributor of material should see it on the ground and in conjunction with the heads of other departments many difficulties can be promptly overcome that would otherwise by correspondence take weeks and months. On these trips, methods and practices can be discussed and action taken to fit the local conditions. I need not recite many advantages that can be secured in the economical and efficient handling of material in close co-operation on the ground between the heads of the Service of Supply Department and the heads of the other departments of the operating organization; the closer the association, the closer the co-operation.

Department Facilities

We will now take up the question of facilities with which the organization has to work. This presents a very broad phase of discussion, and I can only touch on it in a most general way. The heads of every department of a railroad continually have their eyes open for savings in operating expenses that can be effected by capital expenditures, and the savings that can be effected in the material and supply department from this source are as great, relatively speaking, as in the other departments. Every general storekeeper knows the advantages of well-built, well-lighted, properly arranged and adequate storehouses for the care and distribution of material. They know the advantages of adequate lumber and tie yards, platforms, casting and bar iron racks and other facilities necessary in the proper storing of material, and in the distribution of capital expenditures their claims for a proper share therein should be so well presented to the management as to justify them.

The service of supply department should not be content with merely presenting a claim for capital for additional facilities and letting it go at that, but should have back of that claim evidence of a substantial character that the spending of the money is justifiable from an economical as well as every other standpoint. This, of course, requires resourcefulness, initiative, study and persistency of the highest character. I think all of us can remember times when we might have secured facilities had we presented our claim for same in a more explicit way.

There is also another feature to be considered in connection with the facilities. The resourceful storekeeper, by the employment of initiative and industry, can remodel and add to existing facilities in such a way as to increase their capacity to a remarkable degree. Another thought that occurs to me in connection with this particular subject is that care should always be exercised to suit the facilities to the conditions, and all permanent work should be done with a definite plan in view, although its ultimate consummation can be obtained only over an extended period of time.

The proper location of facilities is also of the highest importance. A facility, no matter how well adapted for the storing and care of material that is constructed in such a location as to make the expense of the distribution high is of no more advantage than a poor facility in a good location. This statement may seem axiomatic, but we all know of many instances when there has been construction of unsuitable and improperly located facilities, due to all factors in connection with the storing, handling and distribution of material not having been fully considered at the time the plans were made.

That the best results can be obtained by the closest co-operation between the maintenance, stores and engineering organ-

izations almost goes without saying, and the Service of Supply Department should impress its views upon the other departments with such intelligence, force and convictions that the plans may all be worked out and agreed upon it every essential detail before the application for the capital expenditure is made to executive officers. I believe this will have a tendency to aid in the securing of more and better facilities for the service of supply.

While I would like to discuss more in detail the question of facilities, I must pass on now to the latter phase of performance as modified by methods and practices. They play a most important part in the performance of the service of Supply Department. It would be strange indeed if opinions did not differ as to what constitute best methods and practices. I cannot discuss them except in the broadest way, calling your particular attention to some of the more important ones with respect to which I have, through a wide range of observation, been imbued with very decided personal opinions in regard thereto. For the sake of convenience and not because of their relative value, I will sub-divide them between purchasing and stores departments. The items thus selected are taken largely because of their close connection with the subject of organization, and the part it plays in the successful performance of its function.

Purchasing Department—Price Records

A proper price record is one of the most important tools with which the purchasing department has to work. Its value, however, is largely dependent upon the character of the record and the accuracy and up-to-dateness with which it is maintained. Every road maintains a price record of some character, even though that record may consist only in filed copies of invoices. The results in human achievement are largely determined by comparison or contrast, and when we consider that purchasing agents, in the ordinary course of business, purchase from twenty-five to one hundred thousand varieties of articles, dependent on the size of the road, the utter futility of his remembering the prices of the various items over any extended period of time, is easily visualized. He must, therefore, in determining whether a bid, received on 95 per cent. of the articles purchased, is reasonable, see how same compares with previous purchases. If, in doing so he is forced to examine files of invoices, the amount of valuable time thus consumed is very much in the aggregate and might have been profitably directed in other channels, whereas, with an up-to-date, complete price record, he can see at a glance what he had paid for the article over a series of months, and form his opinions and decide on a line of action promptly. My opinion of a record of this kind is that it should be a loose-leaf continuous monthly record covering all articles, where the amount purchased in a year involves a considerable sum of money. As an adjunct to the price record, it also seems advisable to keep a bid record. This can be maintained in conjunction with the price record, but I believe preferable on cards. This record enables the purchasing agent at any time to determine promptly what a manufacturer may have bid on particular articles of material and may influence and help him in securing lower prices. The value of these records, however, is in proportion to the degree of accuracy and up-to-dateness with which they are maintained. While on its face it would seem that the clerical help thus employed might be used to better advantage elsewhere, one complete item of information may be helpful in saving the salary of the clerk maintaining same for more than a year.

Identification Numbers

Experience and observation has led me to the decided opinion that all items of material purchased by a railroad company in considerable quantities, should have distinctive corporation numbers or symbols. This practice is now being largely applied to castings, air brake parts and stationery. Many railroads have found that a great deal of confusion has resulted from different descriptions at various division points being applied to the same article of material. However, where a distinctive symbol is given to every item of material and this symbol is carried, in addition to the description on requisitions, order, manufacturers' invoices and inventories, the opportunities for mistakes—often costly—is minimized. Many manufacturers as well as railroad purchases and stores organizations, have local or abbreviated descriptions for identical articles of material, which are often not easily recognized or are mistaken for something else by others handling the various documents pertaining thereto. If it is advantageous for air brake material and casting to be given distinctive identification, then it would seem that the same principle could be applied with equal success to other items of material. The extent to which this should be carried, of course, depends largely upon local conditions peculiar to individual railroads. The effectiveness of the practice and the results obtained therefrom are, in the final analysis, greatly increased by the spirit and whole-hearted support which is given to it by all concerned.

Relationship With Manufacturers

This is a subject of vital importance to every purchasing officer and his company, and often upon it rests more than is realized, the results obtained in the purchase of material. I have known of cases where many purchasing officers have failed to receive important trade information and trade benefits because of their attitude towards the people from whom they buy. It is true that in a buyers' market that little consideration can be given the sellers of material and the purchasing officer can drive good bargains, but the relative condition of supply and demand frequently change, and the ability of the purchasing officer is put to the real test in a seller's market. Sellers of material are human and have the same feelings that are common to mankind, and slights and lack of proper consideration for "pedlars" have often resulted in purchasing officials failing to secure the best material at the lowest price at which it could be purchased. I have had representatives of supply concerns say to me, "Well, so-and-so did not give me a square deal, but it is a long lane that has no turning," or words to that effect. Of course, there are times when supply men imagine they are unjustly treated when such is not the case, but generally, my observation has been that they are good losers in fair competition.

It is well not to lose sight of the fact that representatives of supply companies, as a general proposition, are men particularly trained and experienced in their individual lines and usually have not only a general but a technical knowledge of their business, while the purchasing officer dealing with innumerable items of material and supplies, cannot possibly have a full knowledge of all. It is seldom that a genial wide-awake purchasing officer, by discussing with the representatives of supply houses in detail their particular line of business, cannot obtain some information that will be helpful to him in his work.

Stores Department

The supply train is a subject that has been discussed from many angles and in listing it as an item for special treatment I am not unmindful of the fact that there is a diversity of opinion in regard to its operation being a success or failure, but practical experience and a rather extended range of observation leads me to believe that fundamentally the supply train *is* an economic factor in the distribution of materials. The spirit with which the practice is carried out is the governing factor. To be successful in the proper degree, this train should be accompanied by representative division officials of the Maintenance of Way and Transportation Departments who should enter into the spirit of economy with the same zest that should and generally does actuate the storekeeper. The operation of a supply train gives an opportunity for closer co-operation between the division officers of the various departments, and if properly handled, cannot help but result in large economic returns.

The representative of the transportation department has an opportunity to visit stations on a mission distinctly different from the general routine. He can, on such a trip, carefully look into the use of stationery and other station supplies, with a view of securing their most economical use. Likewise, the representative of the roadway department has an opportunity to become acquainted with the economical use of tools and other material; both have the opportunity of picking up surplus material for transfer to other points or return to stock for future use and cleaning up miscellaneous scrap at station and section houses. I have mentioned cleaning up scrap particularly because every supply train should make this as a special function. If all these officers are thoroughly imbued with the thought that material represents actual money and that its proper care and conservation enters into the expense of operation to the same, if not a greater extent, than labor, then proper results will undoubtedly be secured.

The handling scrap and reclaim material is a feature of stores methods and practices that is exceptionally important and

upon its proper handling depends very large returns. All scrap, no matter where located, is the equivalent of its market value in actual money, and only in rare instances can there be failure to realize upon it. Furthermore, all scrap contains a large amount of actual and potential usable material, which can be applied to maintenance purposes rather than purchasing new material.

To secure the greatest returns from the sale of scrap, it should always be assorted into proper classes and sold monthly. It has been the practice on some roads to hold scrap in dull seasons, for a rising market, but a careful study of the subject over a series of years, taking into consideration all the factors that might enter into it, indicates that monthly sales bring the best general results. The money that would otherwise be tied up can always be used to advantage; the lost efficiency that always must occur in disbanding experienced scrap assorters; the lack of a systematic reclaiming of usable material; and the general slackening of interest in the matter, are all debits against the possibly greater amount of money that might be realized by holding the material for higher prices. Of course, such items as wheels, axles, old machinery and rails may at times be held to advantage.

Reclamation of material is always a subject that presents interesting features to purchasing and stores officials. It would seem that from an economic standpoint, there are four general principles of paramount importance:

1st—The cost of reclamation should not be prohibitive.

2nd—Material should be reclaimed only when the advantages derived therefrom are greater than can be obtained from the use of new material.

3rd—Reclamation of all material should be under the jurisdiction of the Storehouse Department.

4th—Use of modern machines and facilities for reclaiming material.

Discussing the foregoing paragraphs seriatim:

1st—Many stores organizations have deluded themselves into the belief that the reclamation of certain items of material was a paying proposition, when as a matter of fact, if all of the factors entering into the cost and use thereof were carefully examined, it would be apparent that it would be better to scrap the old material and buy new. To secure paying returns in this connection, it is well to be sure that every item of cost and all circumstances and conditions relative to its distribution and use are given careful and accurate consideration before reclamation is commenced.

2nd—Many items of material are reclaimed which, when put in actual service, are of such an inferior character that the amounts expended for labor in reclaiming and applying, more than offset the cost of new material. Of course, all mechanics prefer to use new material and in an excess of zeal, some reclamation plants have forced upon the Maintenance of Equipment and Roadway Department material that should never have been used. Every one of these and other phases of the question should be carefully threshed out before the reclamation work is started. It is also essential that a careful inspection should be made of all reclaimed material before it is distributed for application.

3rd—This is also an item upon which there has been difference of opinion, but my belief is that the best results can be obtained by having the reclamation of all material under the jurisdiction of the stores department. The main duty of the stores department is to furnish material, and the main duty of the maintenance department is to use it. Where reclamation of material is under the jurisdiction of the stores department, it is generally given special attention, whereas, if it is under the jurisdiction of the maintenance department it, by the very nature of their duties, it becomes of secondary importance. This would seem to present a fundamental argument of a rather convincing character, without elaborating on others, in justification of the statement made above.

4th—Where actual demonstration of economy has been made in reclaiming of certain items of material, it has been in many instances, nullified to a large extent by the use of obsolete machines and facilities. The old adage that "if a thing is worth doing at all it is worth doing well," applies with full force here. If a bolt threader is discarded by the mechanical department as being out of date, it is certainly out of date for use in the reclammation branch. Surely a triple header bolt, threader, in contradistinction to a single header, can take care of three times as many bolts with the same labor in the reclamation department as it can in the mechanical department. The statement of this fact almost proves itself.

Distribution of Material

The prompt distribution of material and accurate accounting therefore is of major importance in proper operating efficiency. This, in my opinion, should be entirely under the jurisdiction of the stores department. While an increase in the stores department labor forces to distribute material is often looked upon as an item of expense that can be saved, as a matter of fact it is not. The hours wasted by highly paid mechanics in looking for material, when it should have been distributed to them by the stores department, can never be estimated.

The distribution of material by a department not directly interested in its use, is also a check against waste by the other departments. The argument could be presented, however, that there might be such lack of interest in the use as would result in delays in the maintenance departments, but this is seldom the case, as most stores men know, principally for the reason that the maintenance departments keep so constantly after the stores department for the material they have been authorized to use that the latter cannot afford to become dilatory in this respect.

Stock Books

The arguments in regard to the effectiveness and necessity for accurate and up-to-date stock books are almost time-worn, but this practice is not being given the attention to which its importance entitles it. Here again, the value of the practice is dependent largely upon the human equation. To be of the greatest value, the stock book should contain an accurate and up-to-the-minute record of all material on hand, all material on requisition, all material ordered, and the amount used. This knowledge is almost invaluable in ordering and in transferring material, as well as keeping the stock balances within reasonable limits. Imagine the confusion in any large supply house, with hundreds of salesmen on the road and branch stores throughout the country, not having an accurate and up-to-date stock book. A few minutes' reflection on this subject should convince any one, without any extended argument, how almost invaluable are stock books.

A Tribute

In conclusion permit me to pay a tribute to the large number of purchasing and store officials of this organization who have accomplished almost unbelievable results in spite of lack of proper recognition, antiquated facilities, and out-of-date or unsound methods and practices, many of which they were in no wise responsible for. The purchasing agent who faces bills long unpaid, unscientific ordering and urgent demand for immediate delivery, who is able to secure material at a reasonable cost, is not an unfamiliar figure. The general storekeeper, who by hard work, initiative and without adequate co-operative assistance keeps the operating department supplied at a low cost of handling and saving of waste, is not also unknown. Their value in thousands of instances can never be estimated and is often never appreciated. Then think how much greater would have been results had these same men had all that could be desired.

Discussion

I am particularly impressed with the compliment Mr. Wise has paid to the individual storekeeper, the general storekeeper, the purchasing agent, and the general purchasing agent. He is correct in his statement that the greatest handicap has been the lack of men who are primarily fitted for the work to which they are assigned and for which they are held responsible.

The organization which is recommended by Mr. Wise has been generally accepted during the last few years as being fundamentally sound. The need of facilities is of course equally well known. Passing tracks, depots, terminals, shop buildings, and any number of valuable improvements are needed; so that after all we must not be discouraged because we cannot get even the things which we know are so necessary for the economical and proper administration of our affairs. There is a tremendous amount of valuable facilities that can be obtained by pre-

senting constantly the need of these things in a way which will show in dollars and cents the actual savings which can be effected. Many valuable and necessary improvements have been lost because their need has not been shown in the forcible and direct method of measure in dollars and cents.

There can be no question about the needs of a stock book. It is absolutely essential, but in order to get the real benefits from it, it must be maintained. Neither is there any question about the supply train. It is one of the most valuable methods of distribution and control in the stores department. The next step, and a necessary part of it, is the stores delivery system, or what Mr. Wise calls the distribution of material, which means of course the delivery of material to the workman. However, the best of plans never can and never will produce results unless they are applied.

Chairman Ray called upon F. W. Brazier for a few remarks.

F. W. Brazier (N. Y. C.): I want to say that this association is doing a grand work. I am a member of that grand old M. C. B. Association. It is a legislative body, you are an educational body. But your work and our work go together and we want to show the officials of this country that by your work you are making conditions better for all the railroads of the country. Another thing, you come here and you hear something read. Assimilate it and apply it to your own conditions. Don't think you know it all. Get away from home once in a while and learn what others are doing. That is the way to be successful and will help you to reduce the cost of production.

The Chairman: Those kind of talks put enthusiasm into us and we will take it home with us. I want to ask Mr. Yeomans to say a few words to us. He is an old friend of ours and he has fought our battles a good many years.

Geo. G. Yeomans: There is just one thought running through my mind and I do not know exactly how to put it into words. It is what these conventions mean to me and whether we all of us grasp the real significance of what we are here trying to do. We are here to try and profit by what the other fellow has done, not by what we have done ourselves, but get out of our own and into the other fellow's territory and grab away from him all the good ideas that he has. It also involves a sacrifice. In a body of men such as this it is not possible to make any advance toward the general good without giving a little, sacrificing a little, for the good of the whole. That is what these conventions are really for. It is for the general good of everybody, not for the particular good of someone individually, and I do think that if we can carry out this spirit throughout all these meetings that we are going to eventually come to a point where the weak as well as the strong are going to meet on a plane that will elevate all of us.

Upon the motion of F. D. Reed (C. R. I. & P.), a rising vote of thanks was given to Mr. Wise.

Material Accounting and Mechanical Facilities

Some criticism of the 1920 report of the committee, recommending that all material stocks be carried in stores department accounts, is answered in this year's report. The 1920 report in this respect seems to accord with recommendations of the Railway Accounting Officers' Association, and three additional reasons are given why the 1920 report, as originally submitted and approved, should remain unchanged. Valuable recommendations regarding the use of mechanical devices, such as comptometers, adding machines, typewriters, calculating, listing and electric tabulating machines are included in this report.

OBJECTION was entered at the 1921 annual meeting of the American Railway Association to the recommendation made in the previous report of this committee, that all material stocks should be carried in the accounts of the stores department, which will have supervision and handle the accounting for same. It was felt sure that some roads would prefer to have a separate accounting department.

Your committee has given this question further consideration and reports as follows: (The following is an extract from the report of the Committee on General Accounts, Railway Accounting Officers' Association.)

"3. *Accounting for Materials and Supplies.*—The chief accounting officer shall have general supervision and prescribe the accounting for all material.

"4. The officer in whose account the value of the material is carried shall keep such accounts and records, and render such reports to the audit office as prescribed by the accounting department."

Following is an extract from the report of the Committee on Material Accounting, made at 1920 annual meeting of Division VI, A. R. A.:

"Under this assumption it follows that in addition to the movements required in the ordering and physical handling of such materials, it is manifestly within the province of this organization, now known as the stores department, also to supervise and direct the accounting for material as it affects its distribution under the direction of the auditor."

1. Your committee finds, therefore, that its report is in accord with the recommendations of the Railway Accounting Officer's Association.

2. The stores department should handle the primary accounting as a matter of convenience, economy and efficiency.

3. Where the department using material is billed by the stores department and afterwards charged to primary accounts, it makes a duplication of effort and often results in not charging out material in the months account in which used.

4. There is some merit in having a special department do all the accounting, but this is much more than offset by more accurate results with reduced cost when having the work done by the stores department with its detailed knowledge of material and its value.

It is therefore recommended by your committee that no change be made in the report as originally submitted and approved at our 1920 annual meeting.

Mechanical Devices Used in Stores Accounting

Your committee has made investigation as to mechanical devices in use on a great many railroads and finds that practically all are equipped with such devices as comptometers, adding machines, typewriters, calculating and listing machines.

In addition, we have found that several railroads are using an electric tabulating machine.

While these machines have been in use for a number of years in the commercial world and are now in use on numerous railroads in the freight accounting department, they were not adapted to stores department material accounting until 1919. The results obtained since that time justify the use of these machines, due to their accuracy and economy, and they are, therefore, recommended by your committee.

Inasmuch as the system followed in the use of the tabulating machine is a radical departure from the conventional methods in stores accounting, a detailed explanation of the forms and mechanical units of these tabulators is deemed advisable.

Either a blank or a dual card may be used. The dual card, Exhibit A, is preferable, as it entirely replaces the ordinary shop foreman's material requisitions.

The blank card can be used if desired, and by its use the information shown on the shop foreman's ticket is transferred by punching to a separate card.

The dual card is used by the shop foremen in the same manner as the ordinary shop material requisition. The card is then priced and extended by comptometer operator in the usual manner, and is later punched out by a machine, known as the key punch, to indicate the same information in a mechanical way.

There is practically no limit to the number of different punchings that can be made on one card in a single operation, the location of the punchings governing the mechanical action of the machines. The only restriction in the use of these cards is that they must be of uniform size, 3½ in. by 7⅜ in.

The key punch is operated similarly to the typewriter, with only twelve keys and an ordinary operator can punch at an average of three hundred cards per hour.

From this point on all of the accounting is done mechanically; that is, the cards are mechanically sorted and tabulated.

The sorting machine, electrically driven, sorts the cards by account numbers, engine numbers, classification numbers, storehouses, or in any manner desired, after the punchings already made on the cards. By the use of this machine the old method of hand sorting is entirely eliminated, and the cards are sorted with absolute accuracy to any desired combination at the rate of 250 per minute, or 15,000 per hour.

The tabulating machine accurately and simultaneously accumulates any desired totals by groups or sub-groups at a speed of 150 cards per minute, or 9,000 cards per hour.

The total value of material tickets previously sorted and grouped by the sorting machine are run through the tabulator and their value indicated on the machine. Both these machines are automatic and can be operated simultaneously by one operator.

After the values of material indicated by the shop cards have been drawn off or recapped in any manner desired, the cards are filed in classified order under each operating account.

The use of these machines can be adapted to any material accounting situation, including material issues, invoices, vouchers, shop orders and freight charges.

Pay-roll information and analysis can also be handled on these machines.

There is practically no limit to the detailed information which can be secured mechanically through the use of these machines, either daily, weekly or monthly, providing proper provision is made on the cards originally. Their use eliminates the possibility of mistakes due to their mechanical accuracy.

Another important feature in favor of their use is the saving, which can be effected under the old style hand system. On a railroad where monthly detailed accounting averages $500,000.00, a saving of 15 percent in clerical work has been effected over and above the costs of operating the machines.

The greater the volume of the accounting, the more pronounced is the saving.

No special training is required for operation of the machines, outside of a few days' instructions. Speed in punching, of course, is acquired by practice.

There are bookkeeping machines that can be used where the volume of work will justify their expense. The individual railroad of necessity must work out the information as to the advisability of their purchase.

Comparison of Stocks

This committee recommends that some uniform method of comparing stock balance of the various railroads be adopted, and offers the suggestion that such comparisons be on the basis of the

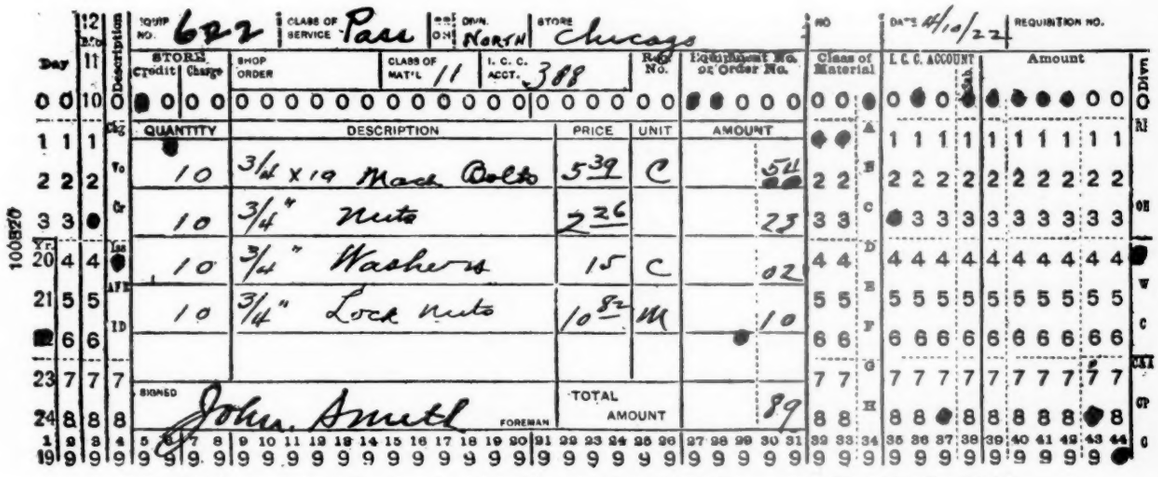


Exhibit A—Dual Card Designed to Replace Ordinary Shop Foreman's Material Requisition

Your committee finds that there is so much involved in this question that they recommend that a special committee be appointed to report on the subject.

The report is signed by D. C. Curtis (chairman), Chicago, Milwaukee & St. Paul, Milwaukee, Wis.; M. B. Bowman, Lake Erie & Western, Lima, Ohio; H. D. Foster, Chicago, Burlington & Quincy, West Burlington, Iowa; L. T. Hoffman, Union Pacific, Omaha, Neb.; W. C. Hunt, Atchison, Topeka & Santa Fe, Topeka, Kan.; O. B. Mills, Pennsylvania System ,Southwest Region), St. Louis, Mo.; G. A. Secor, Chicago & Alton, Bloomington, Ill.; E. L. Zink, Chicago, Rock Island & Pacific, Chicago; and H. H. Laughton (Chairman Ex-Officio), Southern Railway System, Washington, D. C.

The report was read by D. C. Curtis (General Storekeeper, C. M. & St. P.), chairman of the committee, with the recommendation that it be adopted.

Discussion

H. H. Laughton (Southern): The report as it is presented is very complete with the exception that there has been left out that portion which relates to Fuel Accounting. I find that at the 14th Annual Convention of the International Railway & Fuel Association, which was held in Chicago on May 22 to 25 inclusive, the committee report on fuel accounting, as shown in page 1288, Volume 72, No. 22, of the *Railway Age*, has adopted the recommendation of the Purchases and Stores Division of the American Railway Association on Fuel Accounting. It seems that they have adopted something that we have never adopted, therefore, I suggest that the committee be instructed to submit a report on this subject.

Not only is this Fuel Association looking to us for recommendations, but the Association of American Railway Accounting Officers is desirous of the same thing.

W. F. Jones (N. Y. C.): This committee is not to determine who is to do the accounting so much as to determine the method of accounting. We have been trying for many years to get a distinct method of accounting for educational purposes, whether we adopt it or not. Therefore, it would be well to appoint a special committee to consider and report here next year on Fuel Accounting alone, keeping it separate from all Material and Stock questions.

It was moved and seconded that the report of the committee be adopted and that the subject be continued and that a special committee be appointed to consider fuel accounting.

Inventory—Special Subject

Preparation for the taking of inventory and the instruction of employees concerned with the work are concisely described in a special report. The methods employed on one railroad serve as a basis for recommendations for carrying on inventory work in a logical manner.

Office records and listing of materials in transit are provided for; the form of requisitions, stock transfers, invoice records, store orders, price books, etc., are outlined. Listing of new and reclaimed stock; material stripped from equipment and many other items heretofore too difficult to handle in inventories are definitely classified and records provided for.

Methods of recording weights, prices, and accounting are outlined and the accurate tabulation of material values is made possible through a system of computation which provides for price changes.

The recommendation includes listing and classifying of track materials and provides for the utilization of the regular employees at outlying points to handle the inventory of isolated stocks. The report also comments on the inadequate provisions made for inventory in past years and indicates wherein modern methods of accounting may be made to increase the efficiency of the stores department.

ON MANY RAILROADS the taking of inventory is now reduced to a system where it is easily taken care of at each point with the regular Store Department forces.

Preparation for the inventory is the governing factor and a proper inventory can be made only by proper preparation. A good inventory must begin weeks in advance a definite system for preparatoin must be made and definite instructions sent to all officials and all employes; all must be familiar with the instructions. For our guidance we used the following instructions:

GENERAL

1. *Instructions.*—Every member of the Store Department organization must be familiar with these rules.

2. *Date of Inventory.*—Inventory will be taken on dates specified by the General Storekeeper.

3. *Object of Inventory.*—In accordance with instructions issued by the Interstate Commerce Commission, an inventory will be taken of all material and supplies in store stock on the railroad as of midnight of date specified. The taking of this inventory will not only give the Interstate Commerce Commission the total value of material on the railroad, but it will also be the basis of an adjustment of the book balance to the actual inventory. The inventory must be accurately taken.

4. *Scope and Jurisdiction.*—The inventory of all materials and supplies, including commissary supplies, telegraph material and locomotive fuel will be under the jurisdiction of the General Storekeeper. Inventories of the Commissary Department, Telegraph Department and Fuel Department will be taken by members of those departments as directed by the Store Department.

5. *Help Required.*—Necessary help for the proper taking of the inventory will be arranged for by the Storekeeper with the Superintendents or others interested.

6. *Inventory Forms.*—Inventory of all material, excepting track material, will be taken on Form 500. Track material on sections will be inventoried in memorandum books and will be transcribed to Form 500, as described hereinafter.

7. *Preparation for Inventory.*—Preparations for inventory must be started several weeks in advance of the actual taking of the inventory.

All scrap must be sold to the scrap dock. All usable material must be in storehouses or racks neatly piled in units.

Storekeepers must be thoroughly familiar with relation of all material to the stock balance; they must know the location of every piece of material on the division. Places to be given particular attention are, B. & B. tools cars, water service department, work shops, fire department material, racks, points where there are no store department representatives such as small roundhouses and car departments, carpenter shops, blacksmith shops and B. & B. material yards, also bridges, culverts, depots and other buildings and places where material is distributed to be charged out when used, including emergency stocks.

8. *Material with Outside Companies.*—Material purchased and paid for and charged to the stock of material of some division which is being held at the plant of some outside company or manufacturer, shall be included in the inventory of the division to which it stands charged.

If such material has not been charged to stock of material it shall not be inventoried. The value of such material is carried in suspense account by the Auditor of Expenditure, and the General Storekeeper will arrange for necessary record for inventory purposes.

9. *Rejected Material.*—Separate lists on Form 500 will be made of all rejected material and each case will be handled on its merits.

10. *Consignment Stocks.*—Material on consignment will be listed on separate sheets and so marked. Proper care must be exercised to see that consignment is properly segregated and plainly marked. The inventory of consignment material is for record purposes only, its value will not be included in the inventory; the sheets on which such material is listed should not be priced, classified or extended.

11. *Shipping During Inventory.*—Shipments of material between stores should be discontinued one week before date of listing, being confined to shipment of materials necessary to fill emergency requirements only. Each store keeper should arrange with users of material in his territory to see that no material is shipped within three days prior to the actual taking of inventory, except in emergency cases.

12. *Counting and Weighing.*—Material that will cause delay in listing on day of inventory will be counted and weighed in advance. Each person in charge of the counting and weighing shall mark the result of the count on a slip of paper and securely fasten it to the material counted. Parties issuing or receiving any of this material must deduct from or add to the quantities shown on the count any material taken out or any material added. Two bins or shelves containing the same kind of material must be counted and marked separately. The Storekeeper and foreman should make test checks of all counts and weights, as they will be held responsible for accurate results.

13. *Scales.*—All scales must be balanced and put in good working order. Where it is impracticable to use scales, figured weights may be used on such items as bar iron, using Kent, Ryerson or Scully's table of weights.

14. *Inventory of Sections.*—Two weeks before actual listing, storekeepers will sectionalize by definite lines their stocks of materials by buildings, locations and sections, so that callers and listers may be assigned to definite territories of sufficient size to enable them to complete the inventory of each section in one day. Each section should be given a permanent number or letter.

15. *Callers and Listers.*—A list of callers and listers will be made up by the storekeeper and mailed to the general storekeeper, at least two weeks before date of inventory. Each team will be given a card on which space will be provided to show their names, the section they are assigned to, the time they start and the time they complete the work. The card will be filled out as called for and turned in with the iventory, to be used as a permanent record and quide for sectionalizing in future inventories.

Office Record

16. *Office Records.*—All office records and correspondence relating to material affecting inventory must be up to date and in proper shape for reference.

17. *Requisition.*—All charge requisitions, credit requisitions, stock transfers and AFE requisitions covering issues or transfers of material filled prior to midnight of inventory date must be handled to be included in the month account prior to taking of inventory. Storekeepers will see that requisitions for all material used from emergency stock are prepared and accounted for in the month preceding the inventory.

18. *Stock Transfers.*—Form 1722 and 1722-A covering shipments of material made one week subsequent to inventory must be plainly marked on the face of same to show whether or not the material shown thereon has been taken into the inventory of the shipping storekeeper. Rubber stamps reading "Included in Inventory" and "Not Included in Inventory" have been provided for and must be used for this purpose. Storekeepers must review all Form 1722 received and any material shown thereon as having been shipped prior to date of inventory and not received by them, or material shipped subsequent to inventory not included in the inventory of the receiving storekeeper, shall be listed on separate sheets headed "Material in Transit." Care must be exercised to see that material which may be in transit between stores on any division is listed in the inventory.

19. *Invoice Record.*—Invoice records will be divided into live and dead files which should be carefully checked. Receiving sheets must be checked with the invoice records and receiving brought up to date. All material received for which invoices have not been taken into account of the month ending on the day on which the inventory is taken shall be listed direct from Invoice Record to Form 500 and on separate sheets. The amount of these items shall be treated as a deduction from the inventory. Invoices covering material not yet received shall be listed on separate sheets and treated as an addition to the inventory.

Shipments of purchased material on hand at destination pending unloading or in transit shall not be considered as received and therefore shall not be included in the inventory, but shall be taken into receipts of subsequent month on the basis of actual unloading date.

Consignment material which has been used and charged out, but for which stock of material has not yet been charged, shall be treated as purchase material for which invoice has not been taken into account. Such items shall be listed on separate sheets to be deducted from inventory. Particular attention is called to Locomotive Arch Brick, an important item which requires handling in accordance with the provisions of this paragraph.

20. *Store Orders.*—Store orders should be given special attention. All unfinished orders should be completed prior to the taking of the inventory, those which can not be completed should be cancelled as of the date the inventory is taken and new orders issued if necessary. Storekeepers will see that no material is delivered for use on store orders that will not be used up before the inventory is taken. Accountants will see that all completed or cancelled store orders are figured up and necessary charges made in the current month. Where it is not possible to cancel uncompleted store orders a list of charges to such store orders will be made on Form 500 by the accountant and furnished to the storekeeper to be treated by him as an addition to the inventory, it being understood that charges to store orders are carried in stock of material Class 34.

Labor which may have been charged to uncompleted store orwers shall be included in such lists. Storekeepers will confer with accountants in regard to the handling of store orders to see that proper cut-off is made.

Partial deliveries to storekeepers of material manufactured on store orders will be reflected in the regular inventories and accountants must see that proper deductions for such deliveries are made from the lists of charges to uncompleted store orders which they submit to storekeepers.

21. *Price Books.*—Price Books must be kept up to date, showing source of price and all necessary information. New weighted average prices must be figured for all items on which weighted average prices are kept.

22. *Sold Bills.*—At all points where material is sold care should be taken to insure the inclusion in the pervious month's account of all sale bills for material shipped prior to inventory.

23. *Scrap.*—Scrap which may be on hand but which has not been credited to the work from which released must be covered by credit requisition, Form 1728, and taken into the accounts of the month preceding the inventory before it is inventoried.

Listing

24. *Store Stock.*—All store stock must be listed in the inventory. Store stock includes all unapplied material and supplies on the railroad, including commissary supplies, telegraph material and locomotive fuel. Such materials and supplies as are in use and such as have been charged to the proper account or AFE although not yet applied or in use are to be considered store stock and should be inventoried.

Air pumps, injectors, lubricators, engineers' brake valves and other appliances of this nature when not applied or assigned to equipment must be considered store stock. Repaired and needing repair triple valves will not be considered store stock.

25. *Equipment Material.*—Care must be taken not to list or include in the inventory, side rods, locomotive frames, appliances or parts of locomotives or cars, stationary boilers, motor cars, machinery, steam shovels, coal sheds, etc., removed from equipment temporarily while equipment is out of service and undergoing repairs.

26. *Following Material.*—The callers in taking inventory will follow the physical arrangement of the material, i. e., material in racks will be taken as each item is reached, starting at the top and going across, then dropping down one tier, etc., until the entire case is taken. Material piled on floor will be taken in rotation. In no case will the caller follow any alphabetical or numerical arrangement.

27. *Number Copies of Inventory.*—The inventory will be taken in duplicate; an original and one carbon will be made.

28. *Separate Sheets for Each Location.*—Separate sheets must be used for each separate location.

29. *Showing Information Called for.*—All information called for in the heading of each sheet, such as lister's sheet number, lister's name, caller's name, location, division, etc., must be shown.

30. *Erasures.*—Listers must not make erasures on inventory sheets. In case errors are made, lines should be drawn through the wrong items and correct listing done on the following lines.

31. *Numbering Sheets.*—Listers will number their sheets numerically beginning with No. 1 in the space provided. Upon completion of each sheet all unused lines should be diagonally ruled. The last sheet of each lister's inventory must be numbered and marked "Final" in large letters. In case listers move from one location to another they should not begin a new series of numbers, but should continue numbering with the next number following that given to the last sheet of the location that was finished. There should be only one "Final" sheet for each lister.

32. *Calling.*—The caller will call the name of the material first, then the size of pattern number and finally the quantity. The lister will repeat his call as given in each case to the caller.

33. *Checking Sheets.*—At the completion of the sheet the caller will examine the sheet to see that it has been properly filled out by the lister.

34. *Weights, etc.*—Each item shall be listed according to actual kind, weight and measurement at the time listing is done. In cases of large quantities of any kind of small castings, bar iron, etc., which require weighing, a sufficient number of each kind or pattern shall be weighed and the quantity and weight shall be shown on the inventory sheet in the column headed "Lot Weight." The number of pieces weighed shall be shown under the heading "Pieces" and the weight under the heading "Pounds." The total weight will be figured from the lot weighed. In the case of large castings or other material requiring weight, one piece only need be weighed of such kind or pattern and the weight shown on the inventory sheet in the pound column under the heading "Lot Weight." The total number of such pieces on hand shall be indicated in the column headed "Quantity or Number."

35. *Territory.*—In no case should a set of callers or listers go outside the territory assigned to them for taking inventory, without instructions.

36. *Separate Piles*—When listing material of which there are several distinct bins or piles of one item, the quantity in each pile or bin must be listed separately.

37. *Ice.*—The inventory of stock of ice shall be made on the actual measurement, regardless of any book balance or report. The actual measurement of ice as to height, width and length shall be reduced to tons on a basis of 50 pounds per cubic foot of ice.

38. *Emergency Stocks.*—Actual inventory must be taken of all so-called "Emergency Stocks." In no case should inventory of such stock be made from book records.

39. *Signal Material.*—Stocks of Signal Material carried in maintainer's shanties must be listed in the inventory, as these materials are carried in store stock until reported by the maintainers as having been sold. Storekeepers should arrange with maintainers for them to take the necessary inventory.

40. *Legibility.*—The original inventory will not be rewritten and effort must be made to have it neat and legible. A No. 3 lead pencil should be used.

41. *Castings.*—In listing castings the terms "CI" shall be used for cast iron, "MI" for malleable iron and "CS" for cast steel.

42. *Kind of Material.*—Material will be listed as new, S. H. (secondhand) or Scrap.

43. *Needing-Repairs Material.*—Needing-repair material will be listed on separate sheets priced and classified as directed by the storekeeper.

44. *Side Notes.*—All computations and notes in connection with cou ting or listing must be made on the face of Form 500. In listing material where it is necessary for the caller to count and make computations as, so many high, so many wide and so many on top, listing shall be done as follows:

Bolts, Sq. Hd. Machine ⅞ by 18
18 wide by 12 high
10 on top

45. *Proper Description.*—In listing material sufficient description should be given to enable proper pricing and classifying, using a sufficient number of lines for this purpose.

46. *Locomotive Fuel.*—Locomotive Fuel will be inventoried by the Operating and Mechanical Department forces as directed by the Store Department. The fuel inventory shall include all company coal, fuel oil and wood for use in locomotives and shall be listed on separate sheets.

47. *Shop Fuel, Engine Sand, Acetylene, etc.*—Where acetylene, oxygen, shop fuel, engine sand, etc., are charged out when received, they must not be included in inventory.

48. *Marking.*—White chalk will be used for marking material inventoried and where practical the marks should be made on the material itself. As each row or line of material is completed a white chalk mark (X) will be put on the floor where possible to do so to designate that such section has been taken. Care must be taken not to disfigure cases.

49. *Care of Forms.*—As fast as listing is completed, listers shall turn over to the storekeeper both original and duplicate copies of Form 500. When all sheets have been turned in they will be verified to see that each lister's sheets are complete. The storekeeper will then number consecutively in the upper right hand corner the original and duplicate of all sheets, beginning with No. 1 and numbering and marking the last sheet "Final."

Pricing, Accounting, Etc.

50. *Pricing.*—Pricing and classifying, wherever possible, will be done at the time of listing, where not possible as soon as inventory sheets are received and numbered by the storekeeper they will be priced and classified. Both sheets of the inventory will be priced. Stock prices will be applied to all items of new material. Weighted average prices will be used on items where weighted averages have been established, otherwise last prices will be used. Material inventoried as second-hand will be priced in accordance with existing instructions governing pricing of second-hand material. Prices for scrap will be provided by the general storekeeper.

51. *Extensions and Totals.*—For checking, the original copies will be separated from the duplicate and the extensions checked by different persons. As fast as sheets are priced they will be extended and totaled, and errors or differences corrected. The sheets will next be totaled according to buildings and locations, as for example, main storehouse, oil house, iron rack, lumber yard, casting platform, etc. Such subdivisions should be maintained from inventory to inventory for comparative purposes.

A recapitulation of all material showing the value in dollars and cents by classes, which shall include all additions and deductions account material on hand and not charged for, material charged for and not received, etc., shall then be made and furnished to the accountant and this will be the figure shown on the new stock report as representing the value of material on hand as of the date inventory was taken. Copies of this recapitulation shall be sent to the General Storekeeper and District Storekeeper.

52. *Requisitions Filled Before and After Inventory.*—All requisitions covering the issue or transfer of material not listed, which were filled during the week prior to actual listing of the material, shall be included in the accounts for the month prior thereto and shall be stamped or plainly marked "Before Inventory," and shall not be added to the inventory as listed by the Store Department.

Requisition covering material issued or transferred, filled subsequent to midnight of inventory date, but prior to the date that the actual listing is completed, the material not having been included in the inventory by the Stort Department, shall be stamped or plainly marked "After Inventory" for the purpose of indicating cluded in the Inventory."

Such material shall be listed by the Storekeeper, including the prices and extensions as shown on the requisition and considered as an addition to the inventory.

Requisitions covering material issued or transferred, filled subsequent to night of inventory date, but after material has been listed on inventory sheets by the Store Department shall be stamped or plainly marked "After Inventory" for the purpose of indicating that the material covered by such requisitions has been properly included in the inventory, and no further accounting is necessary for such material with respect to the inventory.

53. *Rails and Ties.*—As all unapplied rails and ties will be included in the inventory by the Store Department, Division Accountants are instructed to exert special care to insure the inclusion in previous month's account of all rail and tie transactions.

Track Material

54. *Listing Track Material.*—Inventory of track material on sections will be taken in memorandum books of size convenient to handle. Material on each section must be listed separately, showing exact location, so inventory figures may be used to show quantities on hand in Section Foremen's material report books, Form 2574.

55. *Classification of material.*—Listing shall show complete description, the same as is necessary when ordering material. Blue prints and date showing necessary description should be referred to so that proper listing may be done. Rail should be listed separately as between new, usable and scrap, and the class of track (No. 1 MT, No. 2 MT, No. 1 ST or No. 2 ST), in which the usable rail should be used, classified in accordance with specifications covering classifying rail as issued by the Engineer of Maintenance of Way. The storekeeper or his representative must go over the division to take the track material inventory.

56. *Help.*—The Superintendent will furnish a motor car and instruct either the Roadmaster or an experienced track man to accompany the Storekeeper.

57. *Listing Direct.*—Track material inventory only may be listed in memo. book as described above. All other inventories must be listed direct on Form 500.

58. *Recapitulation.*—A transcription in duplicate of all material listed in memorandum book shall be made on Form 500, and shall be considered the original inventory. The memorandum book from which the transcription is made shall be filed as supporting the inventory.

59 and 60. *Special Recapitulation of Track Material.*—After listing has been completed a special recapitulation of track material shall be made as follows:

On Form 500-A. Covering all new rail, new angle bars and new patented joints.

On Form 500-B. Covering all usable rail, usable angle bars and usable patented joints.

On Form 500-C. Covering all scrap rail, scrap angle bars, scrap patented joints, scrap tie plates and scrap rail anchors.

On Form 500-D. Covering all new tie plates and new rail anchors.

On Form 500-E. Covering all usable tie plates and usable rail anchors.

The recapitulation shall be by Roadmasters Divisions, and shall be made in duplicate, the original shall be sent to the general storekeeper, and the carbon copy to the roadmaster, so that he may have information to make his form 46 reports of rail and track fastenings on hand with actual figures.

61. *Rail and Fastenings.*—Stock of rail and fastenings carried by storekeepers at points other than Savanna Rail Mill, Miles City Rail Yard and Tacoma Rail Yard will be included in the inventory of the roadmaster having jurisdiction over that territory.

The rail and fastenings at Savanna Rail Mill, Miles City Rail Yard and Tacoma Rail Yard now carried by the storekeeper will be inventoried separately from that of roadmasters and reported separately.

Track fastenings carried in storehouses will not be listed in roadmasters inventories but will be listed by the storekeeper direct on Form 500 along with other material.

Ties

62. *Forms.*—The inventory of ties will be taken in the memorandum book along with other track material.

63. *Classification and Listing.*—Cross ties will be listed to show separately treated and untreated ties, each of which classes shall be subdivided as between kinds of woods, as white oak, red oak, hard maple, cedar, beech, fir, etc.

64. *Switch and Bridge Ties, Crossing Timbers and Head Blocks.*—Switch ties, crossing timbers and head blocks shall be listed in the same manner as cross ties, but shall in addition show the size, length, width, thickness of each tie, timber or block.

65. *Ties at Treating Plants.*—The inventory of ties at treating plants will be arranged for by the general storekeeper.

66. *Ties Produced on Division.*—On divisions which produce ties, care should be taken not to include in the inventory any ties which have not been inspected and accepted by the tie inspector.

67. *Ties in Transit.*—Ties in transit from one division to another or from one point on a division to another point on the same division shall be inventoried as provided for in Section 18 of these instructions.

68. *Ties Distributed Along the Right-of-Way.*—All ties distributed along the right-of-way ready to put into track must be included in the inventory.

Final

69. *Disposition of Inventory.*—The original inventory complete with recapitulation by classes shall be sent to the accountant. The duplicate will be retained by the storekeeper.

Paragraph 15 provided for the callers and listers. It is the practice to use all the clerks from the office, girls as well as the men, for the listers, using experienced help in the sections for the caller.

The line material should be taken thirty days in advance of the Store Department material. This enables the Store Department forces to go out on the line, property list and check all line material and then work the figures forward for that month and include them with the regular inventory.

A tag should be provided for each material item. This tag should show proper description, class, line and page in the stock book, and on the C. M. & St. P., we also show the price. The pricing and classifying are done at the same time as listing of the inventory. All work of listing, pricing, extending and drawing up summary by classes ready for the accountant to make adjustment should be done by the Storekeepers' forces.

The forces should be so organized that the inventory at the store point is listed in one day and the extending, summarizing, etc., should be closed up in one week. Listing of an inventory in one day, the extending and summarizing in one week is not only possible but very practicable. If work on the inventory is allowed to drag and is done intermittently, it interferes with the regular routine to such an extent that the inventory becomes a secondary consideration with consequent errors.

To have good inventories not only must proper preparation be made, proper rules and regulations given, but sectional stockmen must be educated as to the value of material in their charge, the value of proper accounting and their responsibility for the proper ordering, distributing and care of the millions of material dollars that come out of the treasuries of the railroad and for which storekeepers, assume the responsibility.

The report is signed by D. C. Curtis, General Storekeeper of the Chicago, Milwaukee and St. Paul.

(The report as read by D. C. Curtis was accepted as Recommended Practice.)

Report on Reclamation of Material

THIS SUBJECT is of vital importance, as past experiences have very clearly demonstrated that large savings can be effected by giving this work proper co-operation and attention, and we therefore reiterate and urge that this principle be followed out to fullest extent in our future activities.

We have given consideration to previous reports on this subject, all of which have covered the work thoroughly from various viewpoints, but it was realized that we should endeavor to submit something in the nature of constructive work that could be formed as a basis for future activities and decided, therefore, to recommend the following:

1. General Reclamation Plant Layout (Exhibit A).
2. Classified List of Material and Supplies to Be Reclaimed, Showing Operation and Facilities Necessary (Exhibit B).
3. General Suggestions Pertaining to Reclamation of Material and Supplies (Exhibit C).
4. Progress Made in Reclaiming Chipped Rail Ends, Frogs and Switches in Track.
5. Additional Forms (Exhibit D).

1. General Reclamation Plant Layout (Exhibit A)

The drawing submitted of a general reclamation plant layout is so arranged as to be sufficiently elastic to take care of the needs and requirements of the large, as well as the small, railroads.

On this print is shown the general layout of the entire plant, including the following: Scrap yard, reclamation yard, trackage, paved driveways, machinery and appliances, buildings and structures, location of each department, class of work and function to be performed by each department, and proposed organization.

This year's report of the Committee on Reclamation is considerably more extensive than the one presented in 1920. The report is marked by commendable thoroughness in detail, making it valuable for reference on questions of standard practice.

Exhibit B shows a classified list of material to be reclaimed, together with the operations and equipment required, and the suggestion that Exhibit B be printed in pamphlet form for distribution to members of the association is a good one. Special attention is given to the reclamation of rails with chipped ends, frogs and switches in the track by building up with welding. This process saves not only rails, frogs and switches, but also the labor involved in replacing them. Further investigation along this line should provide additional information on the relative advantages of gas and electric welding for this work, together with a comparison of costs and wearing qualities.

As indicated in the opening statement of the committee, reclamation is a subject of vital importance, presenting the possibility of great saving. There is also a possibility of serious loss, or at least failure to realize maximum savings, unless the railroads co-operate in comparing practices and checking the cost of reclamation work against continually varying labor and material costs.

The layout contemplates the handling of scrap by cranes equipped with magnets. The material to be reclaimed is to be handled in and out of plant by tractors.

2. Classified List of Material and Supplies to Be Reclaimed, Showing Operation and Facilities Necessary (Exhibit B)

There is also submitted a revised list showing operation and equipment required for various kinds of material and supplies, which has been arranged in classified order, as it is the belief of the committee that this arrangement will better suit the purpose than alphabetical arrangement of items.

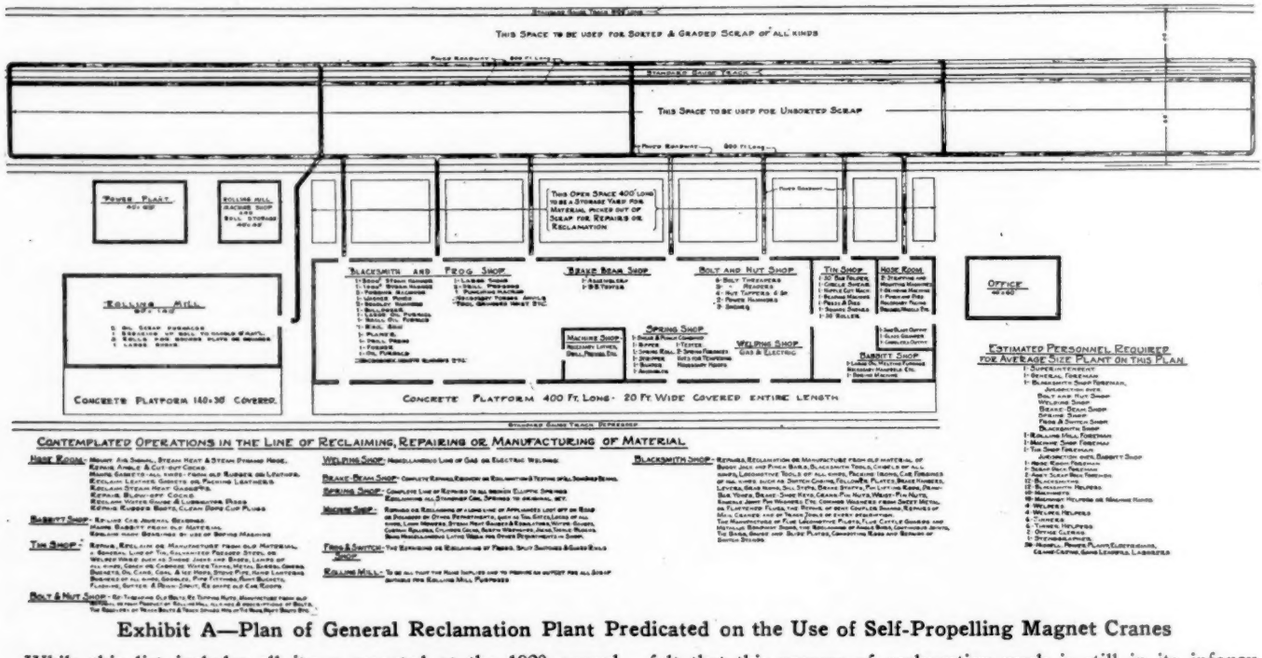

This Space to be used for Sorted & Graded Scrap of all kinds
This Space to be used for Unsorted Scrap
This Open Space 400' Long to be a Storage Yard for Material picked out of Scrap for Repairs or Reclamation
Power Plant
Rolling Mill
Blacksmith and Frog Shop
Brake Beam Shop
Bolt and Nut Shop
Tin Shop
Hose Room
Office
Machine Shop
Spring Shop
Welding Shop
Rabbit Shop
Concrete Platform 140 x 30 Covered.
Concrete Platform 400 Ft. Long - 20 Ft. Wide Covered Entire Length
Estimated Personnel Required for Average Size Plant on this Plan.
Contemplated Operations in the Line of Reclaiming, Repairing or Manufacturing of Material.
Hose Room:
Rabbit Shop:
Tin Shop:
Bolt & Nut Shop:
Welding Shop:
Brake-Beam Shop:
Spring Shop:
Machine Shop:
Frog & Switch Shop:
Rolling Mill:
Blacksmith Shop:

Exhibit A—Plan of General Reclamation Plant Predicated on the Use of Self-Propelling Magnet Cranes

While this list includes all items reported at the 1920 annual meeting of the division, there has also been added a number of new items.

In submitting the list referred to the committee has in mind that it will be revised from year to year as new ideas develop, so that an up-to-date list will be maintained at all times.

It is suggested that this list be printed in separate pamphlet form, so members of the association can obtain as many copies as desired for distribution among their employees.

3. General Suggestions Pertaining to Reclamation of Material and Supplies (Exhibit C)

We have compiled a classified list showing general suggestions in connection with reclamation work, which it is considered should be beneficial and should be placed in the hands of employees whose duty is to handle scrap.

We recommend this list be revised from time to time in the same manner as the list showing material to be reclaimed, and that this form a supplement to said reclamation list and that it be kept up to date and finally become a valuable source of information.

4. Progress Made in Reclaiming Rails with Chipped Ends, Frogs and Switches in Track

The committee has made a study of this line of reclamation and finds that several roads have made considerable progress. It is felt that this process of reclamation work is still in its infancy, but in view of what has so far been accomplished, the committee urgently recommends that it be further advocated, inasmuch as there are great possibilities of saving to the railroads.

It may be of interest to know that our investigations have determined an estimated saving of 72 per cent in the building up of a worn frog in track in lieu of replacing with a new frog; also a saving of 66⅔ per cent in building up switch points in track.

Consideration should also be given to the labor consumed in replacing a worn-out frog with a new one or a set of switch points with new, as well as the capital investment of stocks of new frogs and switches, which can be materially reduced by rigidly following the reclamation practices referred to.

The building up of chipped rail ends in track by means of weld-

ing is a reclamation feature of recent innovation and brings about substantial saving, which is self-evident when it is considered that if rails were not so reclaimed it would mean they would have to be taken out of track, replaced with similar kinds, either new or first-class second-hand, respacing of ties, building up the road bed, picking up of all rail from track and transporting this and the new rail to and from the job, as well as investment in large sums in new rail.

5. Additional Forms (Exhibit D)

Previous committees have covered this field quite thoroughly, and we therefore have but one form to recommend, entitled "Suggestions for Reclamation," copy of which is appended hereto.

The object of this form is to obtain suggestions, not alone from reclamation plant, but from various shops and other institutions and employees of the railroad, and in this manner have the widest field possible for the increase in reclamation work.

Another object of the form is to clearly demonstrate whether the process suggested is economical, which should at all times be definitely settled before adopting or following out any particular line of reclamation work.

This form also to be used in obtaining the approval of the head of the using department when desired, and when approved becomes a standard item of reclamation.

General Remarks

The subject of conservation of railroad material and supplies is featured more and more on various railroads and it is therefore expedient that this all-important subject be recognized by this Association, and in view of its close relation to reclamation work we recommend that future committees on Subject III, Section VI, A. R. A., be also entrusted with this subject and that the heading of the subject be revised to read "Conservation and Reclamation."

We further wish to reiterate what has already been recommended to this Division in past years; namely, the essential necessity of all employees on railroads co-operating to the fullest extent so as to bring about the best and most complete results in reclamation work; in other words, the committee desires to amplify the importance of thoroughly advertising the subject of conservation and reclamation.

The report is signed by O. Nelson (Chairman), Union Pacific, Omaha, Neb.; Wm. Davidson, Illinois Central, Chicago, Ill.; R. J. Elliott, Northern Pacific, St. Paul, Minn.; W. J. Diehl, Mobile & Ohio, St. Louis, Mo.; R. C. Harris, Pennsylvania System (Central Region), Pittsburgh, Pa.; B. W. Griffith, New York Central, (West) Collinwood, Ohio; K. R. Stewart, Atchison, Topeka & Santa Fe, San Bernardino, Calif.; E. A. Workman, Baltimore & Ohio, Baltimore, Md., and W. A. Summerhays (Chairman Ex-Officio), Illinois Central, Chicago, Ill.

Exhibit B

RECLAMATION CLASSIFICATION

and

RECOMMENDED PRACTICES IN CONNECTION WITH RECOVERY OR RECLAMATION OF VARIOUS ARTICLES, APPLIANCES, MATERIAL AND SUPPLIES.

Item No.	Classification and Description	Operation	Equipment Required
	Class 1-A		
1	Bars, head	Worn holes—upset or welding and redrill	Welding or smith shop equipment
2	Bars, tie	Worn holes—upset or welding and redrill	Welding or smith shop equipment
3	Clips, transit, for split switches	Can be made from old boiler plate. Also remove serviceable clips from scrap switch points	Smith shop equipment
4	Cranks, switch stand	When bent, not cracked—straighten and put back into service	Nothing special
5	Crossings, railroad	When battered or worn—build up in track by welding process	Welding apparatus
6	Frogs, rail	Build up by welding process	Welding equipment
7	Frogs, rail	Repair by utilizing second hand parts as far as possible	Frog shop equipment
8	Plates, switch slide	When bent, heat and straighten	Smith shop equipment
9	Points, switch, worn	Swedge to standard height and redress on planer	Frog shop equipment, etc.
10	Points, switch, worn	Build up by welding process and dress by emery grinder	Welding equipment
11	Rails, guard	Can be made from second hand rail	Frog shop equipment
12	Rods, connecting	Worn holes—upset or welding and redrill	Welding or smith shop equipment
13	Stands, switch	Make standard repairs	No special equipment
14	Tables, switch stand	When cracked or broken—repair by welding process	Welding equipment
	Class 1-B		
1	Bars, angle	Worn holes—plug and drill new holes	Smith shop equipment
2	Bars, angle	Straighten and reform	Smith shop equipment
3	Bolts, track	If not too badly rusted, use circular steel wire brush to clean threads	Stand and circular steel wire brush
4	Bolts, track	Cut down to next smaller size and fit with standard U. S. thread nut	Bolt cutter and threader
5	Joints, continuous	If cracked, or with uneven surface on top repair by welding process	Welding apparatus
6	Joints, continuous	When worn on shoulder or top surface heat and reshape	Furnace and dies
7	Plates, tie	If bent, heat and straighten	Smith shop equipment
8	Plates, tie	Repunch for other sections of rail	Power punch and dies
9	Spikes, track	Straighten if not too badly cut under throat	Quick acting power hammer
	Class 1-C		
1	Bars, Claw	Redress and straighten. Apply new ends if needed	Furnace and power hammer
2	Bars, claw	Manufacture into lining bars	Furnace and power hammer
3	Bars, lining	Redress and straighten	Furnace and power hammer
4	Bars, tamping	Redress and straighten. Apply new ends if needed	Furnace and power hammer
5	Bits, round shank track drill	Flatten for use with Rich Spindle and Chuck	Nothing special
6	Bits, flat track drill	Can be made to advantage from old files	Smith shop equipment
7	Chisels, track	Change from convex to concave, obtaining necessary length for repairs	Smith shop equipment
8	Chisels, track	Redress and sharpen	Smith shop equipment
9	Cutters, weed	Manufacture from old track shovel blades	Nothing special
10	Cylinders, motor car	When over-size, scored or worn, bore out and bush	Machine shop
11	Drills, track	Repair, using old serviceable parts	Nothing special
12	Handles, old wood	Cut down to smaller lengths and use for tool handles	Nothing special
13	Jacks, track	Repair, using old parts as far as practicable	Nothing special
14	Picks, all kinds	Redress. Apply new ends made from scrap tire steel	Smith shop equipment
15	Punches, track	Can be made from short spike mauls	Nothing special
16	Plugs, spark	Repair by using second hand parts as far as possible	Nothing special
17	Shafts, motor car crank	When worn, turn and bush	Small lathe or Marriott Machine
18	Shovels and scoops	Utilize serviceable blades on scrap handles or vice-versa	Machinist's vise, hammers chisels, punches, etc.
19	Shovels and scoops	Cracked in blade or split in strap on shank can be welded	Welding apparatus
20	Tools, various, such as nail pullers, bars, etc.	Manufacture from scrap coil springs	Nothing special
21	Wheels, pressed steel motor, hand or push car	Build up worn flange or worn tread by welding process	Welding apparatus
22	Wrenches, track	Jaws redressed	Small furnace and power hammer
	Class 2-A		
1	Cases, battery carrying	Remove serviceable parts before placing in the scrap	Nothing special
2	Elevators, battery	Remove serviceable parts before placing in the scrap	Nothing special
3	Poles, metallic signal	Cut down and use for bell posts, relay posts, etc.	Nothing special
4	Roundels, colored	Broken or unbroken have a market value	Nothing special
5	Straps, fibre side	Manufacture from second hand side plates	Hand saw and drill
6	Wire, copper insulated	Subject to slight heat only, in removing insulation	Nothing special
	Class 2-B		
1	Cells, standard 2½ x 6	Strip and utilize zinc, carbon, sealing wax	Stripping machine
	Class 3		
1	Bases, smoke jack	Manufacture from old metallic roofing	Tin shop
2	Flashing, Guttering, etc.	Manufacture from old metallic roofing	Tin shop
3	Sacks, cement	Clean in revolving rattler made of second hand lumber and poultry netting, or other home-made device	Power driven rattler

Exhibit C

GENERAL SUGGESTIONS IN CONNECTION WITH RECOVERY, REPAIRS OR RECLAMATION OF VARIOUS MATERIALS AND SUPPLIES

Class 1-A

1. Tie bars, head bars, connecting rods and similar parts should not be disposed of as scrap unless they are beyond repairs or beyond upsetting or welding and redrilllng.
2. Care should be used in disposing of any frogs or split switches in the scrap. In case of doubt, hold up the article, awaiting further inspection.
3. Old type switch stands need not necessarily be scrapped. They can be repaired by using parts of other stands and used in back tracks.
4. Switch stand cranks which are bent but not cracked can be straightened and put back into service.
5. Cracked or broken switch stand tables can be safely Oxwelded and used in repairs to switch stand for back track service.
6. Scrap frogs should not be cut apart by track men or others merely to facilitate loading.
7. Railroad crossings can be built up in track or Oxweld process with obvious saving.
8. Trans clips for split switches can be manufactured if desired out of old boiler plate.
9. Switch stands on other parts of same should not get away in the scrap.
10. Gauge plates, slide plates, and similar switch parts can be repaired by one process or another and put back into service.
11. Split switch points, worn or broken, can safely be built up by welding process and put back into service.,

Class 1-B

1. Old track bolts larger than 13-16 inch can be cut down to smaller diameter and used with standard machine bolt nuts, also can be upset and rethreaded.
2. Old continuous joints should not be disposed of as scrap unless they are cracked or broken or worn to thin edge on the base.
3. Slow moving tie plates can be repunched to other sections and gotten into service.
4. Track spikes not excessively throat worn can be strengthened and reissued.

5. Tie plates should not be scrapped unless they are cracked or broken or worn to knife edge.
6. Old continuous joints with uneven top surface caused by low joint action can be reshaped.

Class 1-C

1. Old wooden handles can be cut down to smaller lengths and used economically for tool handles.
2. Shovels or scoops with slight cracks in blade or slight splits in strap or shank can be welded. "P" shovels and scoops should not be put through the fire in order to burn the wood, as it destroys the temper in the steel.
3. Malleable "D" grips or serviceable wooden handles should be properly taken care of.
4. Satisfactory flat track drill bits can be manufactured from old files.
5. The contour on track chisels can be changed from convex to concave and thus obtain additional length in repairs.
6. A satisfactory weed cutter can be made from short track shovel blades.
7. Track jacks can be repaired in many ways, lost motion in the standard being taken up by inserting a plate of iron or steel, or by building up by oxweld.
8. Track punches can be manufactured out of short spike mauls.
9. Round shank track drill bits can be flattened so as to fit Rich spindle and chuck.
10. A number of roadway tools such as nail pullers, bars, etc., can be made from scrap coil springs.
11. Pressed steel motor car, hand car or push car wheels should never get in the scrap unless absolutely worn out, broken or beyond repairs. There are different methods of reclaiming these.

Item No.	Classification and Description	Operation	Equipment Required
	Class 4		
1	Butts, pile	If long enough, split and use for stock yard or fence posts	Nothing special
2	Butts, pile	Resaw and use for box culverts	Circular saw
3	Signs, metallic roadway	Manufacture from old material	Smith and tin shop
4	Timber, old bridges	Resaw to make standard size lumber	Circular saw
	Class 5-A		
1	Ties, switch, oak	Saw up to take care of temporary shortage of car and locomotive oak	Mill equipment
	Class 6		
1	Bridges, iron	Such as held for use. Paint periodically and mark date thereon	Nothing special
2	Turntable parts, rollers and bearings	If worn out of round, bore out and bush	Nothing special
	Class 8		
1	Rails	Battered ends. Saw off and redrill	Rail mill
2	Rails	Clipped ends. Build up in track by welding	Welding equipment
	Class 9-A		
1	Scales	When broken or in bad order repair and put back into service	Scale shop equipment
2	Tanks, air or gas	When not fit for original purpose use for storage of liquids by necessary alterations	
	Class 9-B		
1	Coal chute or coal conveyor parts	Repair and put back into service	Machine or smith shop equipment
	Class 11		
1	Bolt ends with nuts	Remove nuts for retapping	Bolt and nut shop equipment
2	Bolts, large diameter	Where long lengths are needed, weld two bolts together to make necessary length	Smith shop equipment
3	Bolts, car	Sort to size, straighten and rethread	Power hammer, shear and bolt threaders
4	Bolts, engine	Cut down large sizes to smaller, either in length or diameter	Machine and bolt shop equipment
5	Bolts, stay	Rattle and hammer into slabs and use for locomotive forgings	Rattler and power hammer
6	Nuts	Sort to size, retap and place in stock	Sorting table, rattler and nut tapper
7	Washers	Sort to size and clean in rattler	Rattler and sorting tables
8	Washers	Can be made from old sheet metal or from scrap flues flattened	Washer punch
	Class 12		
1	Springs, elliptic	"S" wrenches can be made from broken leaves	Smith shop equipment
2	Springs, coil	Retemper and bring up to original set	Spring shop equipment
3	Springs, coil	Manufacture nail pullers, chisels and similar tools	Smith shop equipment
4	Springs brake cylinder	Manufacture packing hooks and irons	Smith shop equipment

12. It is not proper to Oxweld sledges or similar tools subject to strenuous service.
13. In cutting rivets from track hovels, a cold chisel seems to be preferable to boring out the rivets.
14. Old claw bars beyond repairs as such can be manufactured into lining bars.
15. Repaired track shovels should be dipped in the blade in black paint before being shipped out on the line.
16. Motor car crankshafts which are worn can be turned, bushed and made more serviceable than before.
17. The question of boring out motor car cylinders and applying a bushing is a subject open to debate.
18. Spark plugs which can be economically repaired and use found for them after repairs, should so be handled.

Class 2-A

1. Side strips can be manufactured from second hand fiber side plates.
2. Old metallic signal poles can be cut down and used for bell posts, relay posts, etc.
3. Old battery elevators or carrying cases should not be disposed of without removing serviceable parts.
4. Broken or colored roundrels have a value and should not be thrown away on the dump.
5. Insulated scrap copper wire should be subjected to only slight heat to remove the insulation.

Class 2-B

1. Standard dry cells, 2 1-2 by 6, can easily be stripped and the zinc, carbons and sealing wax utilized in proper way.
2. Old wire, in addition to being used for stripping open cars, is also valuable for tying up material of various kinds for shipment.

Class 3

1. The question of cast iron pipe in dead water lines should be periodically looked into.
2. The matter of using surplus cast iron elbows for culvert work is open to debate.
3. The matter of finding use for sludge from water softeners is open for comment.
4. Empty sacks of every description should be properly taken care of, as they have a return value.
5. Smoke jack bases, flashing, guttering, down spout, etc., should be manufactured from old material so far as practicable.
6. A cement rattler for cleaning cement sacks can be fitted up at nominal expense.
7. Old burlap sacks have a value and should not be thrown on the dump.

Class 12

1. No unbroken coil or elliptic springs should be thrown away in the scrap without the most rigid inspection.
2. "S" wrenches can be manufactured from broken leaves of elliptic springs.
3. Coil springs can be retempered and brought up to standard set.
4. Nail pullers, chisels and similar tools can be manufactured from scrap coil springs.
5. Packing hooks and irons can be manufactured from brake cylinder springs.

Class 13

1. All flues turned over as scrap should be properly passed on by M. P. & C. Department. No flues should be disposed of as scrap unless the scale has been removed, indicating proper inspection.
2. Snow fence stakes can be made from scrap flues.
3. Scrap superheater flues should be kept separate from other flues, as they bring higher price.
4. Fence posts can be made from old locomotive flues.

Class 14

1. Scrap zinc can be used for acid cutting purposes in preference to new zinc.

	Class 15		
1	Flues, scrap	Manufacture sign posts	Smith shop equipment
2	Flues, scrap	Manufacture snow fence stakes	Smith shop equipment
3	Flues, scrap	Cut to suitable length and use for fence posts	Usual shop equipment
	Class 14		
1	Babbitt	Manufacture from various metals accumulating in scrap yard or reclamation plant	Babbitt shop equipment
2	Ferrules, copper	Remove from scrap flues	Nothing special
3	Metals, brass foundry cleanups	Separate metal of highest value	
4	Zinc, scrap	Use for acid cutting in preference to new	
	Class 15		
1	Cable, second hand steel	Splice and make into switch ropes	Nothing special
2	Iron, round	Short pieces of new iron accumulating at shear can be made into bolts	Bolt shop equipment
	Class 16		
1	Iron, welding	Use scrap or second hand in preference to new welding iron or new rods for rough work	Welding apparatus
2	Steel sheets, second hand	From coal chutes and similar places. Use in manufacture of ash pans, steel car work, etc.	Regular shop equipment
	Class 17		
1	Axles, car	Manufacture into knuckle joint pins, wrist pins, etc.	Smith shop equipment
2	Axles, locomotive driving	Manufacture into locomotive crank pins, piston rods and similar forgings	Smith and machine shop equipment
3	Pins, worn draw bar	Use for driver brake pins, trailer, equaliser and spring hanger pins. Hammer out and use for brake levers and similar forgings	Smith and machine shop equipment
4	Rods, locomotive piston	Manufacture into pins of various kinds	Smith and machine shop equipment
	Class 18		
1	Beams, brake	Repair all standard beams using second hand parts so far as practicable	Brake beam shop
2	Bolsters, truck-side frames, etc.	Repair by welding process when permissible under A. R. A. rules	Welding apparatus
3	Forgings, car	Manufacture large variety out of second hand or scrap material	Smith shop equipment
4	Keys, brake shoe	Manufacture from over accumulation of short length machine bolts	Bradding hammer
5	Levers, brake	Straighten and return to service. Upsetting or replugging holes and redrilling	Smith shop equipment
6	Members, running board	Repair by welding process or splice	Welding and smith shop equipment.
7	Pins, old knuckle	Straighten	Smith shop equipment
8	Pins, broken carbon steel coupler and knuckle	Can be used for making hand chisels	Smith shop equipment
9	Planks, spring	Splice if practicable	Smith shop equipment

2. Brass foundry cleanups should be carefully watched and under no circumstances thrown on the dump.
3. Copper ferrules should be removed from scrap flues before being turned over to the State Department.
4. A satisfactory babbitt can be manufactured from various metals accumulated in scrap yards or reclamation plants.
5. Aluminum letters or figures should not be permitted to get away in the scrap, but used for local consumption.

Class 15

1. High speed chips, borings, etc., should be properly taken care of, as this scrap brings a high price.
2. New galvanized iron should not be used where old metallic car roofing will answer as well.
3. Short pieces of rounds accumulated at shear or elsewhere should be periodically cleaned up and made into bolts.

Class 16

1. Secondhand sheets from coal chutes and similar places can be used in manufacture of ash pans, steel car work, etc.,
2. Old material should be used as far as possible for rough welding work in preference to new welding iron or new rods.

Class 17

1. Old axles or piston rods can be manufactured into crank pins, knuckel joint pins, Wrist pins, etc.
2. Old locomotive driving axles can be manufactured into locomotive piston rods and similar forgings.

Item No.	Classification and Description	Operation	Equipment Required
	Class 18 —Continued		
10	Rods, brake, with serviceable jaws	Weld on rods	Smith shop equipment
11	Rods, bottom connection	Straighten if bent	Smith shop equipment
12	Steps, sill	Can be manufactured out of round iron in preference to flat if surplus round iron on hand	Smith shop equipment
13	Trucks, complete	Dismantle and utilize component parts when can be used for no other purpose	Nothing special
	Class 19		
1	Casing, cylinder head	When bent, straighten	Smith shop equipment
2	Collars, crank pin	When threads are worn, turn down, build up by welding process and turn to original size	Welding and machine shop equipment.
3	Heads, piston	Half sole with bronze mixture	Welding apparatus
	Class 20		
1	Boxes, oil or pedestals	When worn, build up by welding process if practicable	Welding apparatus.
2	Couplers	Straighten bent shanks	Smith shop equipment
3	Couplers	Change size of butt by adding plates or slabs	Welding apparatus
4	Coupler parts—other than knuckles	Build up worn parts by welding process	Welding apparatus
5	Knuckles, couplers	Build up worn surface by welding process	Welding apparatus
6	Levers, release rigging	If bent, straighten	Smith shop equipment
7	Pins, broken knuckle	If long enough, use for spring hanger pins	Smith shop equipment
8	Pins, carbon steel knuckle	Use in manufacture of chisels	Smith shop equipment
9	Roofing, old car	Reshape and use as roofs	Tin shop equipment
10	Roofing, old car	Use for various buckets, oil cans, down spout, flashing, decking on bridges, building roofs and similar purposes	Tin shop equipment
11	Shoes, brake, with steel backs	If of considerable thickness, save and weld on broken eye	Welding apparatus
	Class 21		
1	Bearings, journal	Reline	Babbitt shop equipment
2	Bearings, journal	Slight boring in patent boring machine	Boring machine
3	Bells, locomotive	When cracked, repair by welding	Welding apparatus
	Class 22		
1	Cocks, angle and cut-out	Repair and regrind	Grinding machine and lathe
2	Gaskets, triple valve and brake cylinder	Reclaim	Wire brush, castor oil, tallow and beeswax, or similar process
3	Glasses, air pump lubricator	Clean and repolish	Vat and buffing wheel
4	Heads, air and steam piston	Turn down to smaller diameter	Machine shop equipment
	Class 23		
1	Boxes, sand hose strainer	Build up stripped threads by welding and re-thread	Welding apparatus
2	Cups, sand blast	Fill worn holes by welding process	Welding apparatus
3	Discs, bullseye lubricator or flange oiler	Clean and repolish	Vat and buffing wheel
4	Glasses, water gauge	Clean and regrind	Vat and grinding machine.
5	Stoker material	Reclaim or repair	Nothing special

3. Locomotive piston rods should never be disposed of as scrap, as they can be used to advantage in the manufacturing of pins and similar items.
4. Any practicable scheme for reclaiming knuckle joint pins is a subject for debate.
5. Sufficient scrap knuckle joint pins should always be retained for the manufacture of smaller pins and avoid unnecessary labor in turning down axle or piston rod steel.
6. Worn locomotive draw bar pins can be used for driver brake pins, trailer equalizer and spring hanger pins; can also be hammered out and used in the manufacture of brake levers and similar forgings.

Class 18

1. Care should be used before scrapping any brake levers if they can be repunched to standard size.
2. Sill steps can be manufactured out of round iron if desired, to use up old material in preference to new flat iron.
3. Brake rods with serviceable jaws should not get away in the scrap.
4. Brake staffs of standard dimensions should not be disposed of as scrap.
5. Broken draw bar yokes with thimbles attached should not get away in the scrap until the thimbles have been removed.
6. A large variety of car forgings in this class can be manufactured from scrap or secondhand material.
7. Bolsters, truck side frames and similar parts which can be properly welded should not be disposed of as scrap.
8. The various M. C. B. brake meams should be kept out of the scrap with the idea of repairing and putting back into service.
9. Care should be used to not scrap any serviceable carlines.
10. Bottom connection rods should not be scrapped unless broken, as these can be straightened.
11. Running board members should not be scrapped unless beyond welding or splicing.
12. Passenger brake beams for repairs and serviceable or repairable parts should be kept out of the scrap.
13. Complete trucks should not be permitted to accumulate. They should be dismantled and component parts utilized when no other use can be found for them.
12. Keys, brake shoe, can be manufactured to advantage from over accumulation of short length machine bolts, with the use of the hammer.

Class 19

1. Locomotive brake shoes, either new or secondhand, with broken end lugs, should not be picked out of the scrap.
2. Standard dope cup plugs should be kept out of the scrap. Those picked up by supply train should not be placed in the scrap car.
3. Solid piston heads can be reclaimed by building up with bronze.
4. Steel crank pin collars with worn threads can be turned down, built up again and threads turned to original size.
5. Pressed steel cylinder head casings, valves, head casings, cylinder heads and such parts as are sometimes lost on road to be picked up by supply train should be kept out of the scrap.
6. Serviceable or repairable parts of driving box lubricators should be kept out of the scrap.

Class 20

1. Scrap accumulation should be carefully watched for serviceable oil boxes.
2. The matter of oxwelding oil boxes or pedestals should be carefully watched, as the work is liable to be done at a considerable loss.
3. Thick car brake shoes with steel backs with broken eyes should be kept out of the scrap with the view of welding on eyes.
4. Thimbles or packing blocks should be promptly removed from broken yokes and placed in stock.
5. See Class 50 for tentative definition for serviceable car or locomotive brake shoes .
6. Couplers or knuckles can not be oxwelded for cracks or fractures, but no standard articles should be scrapped on account of being worn.
7. Broken knuckle pins, 1½inch and 1⅝ inch, not shorter than 5¾ inches, can be used for spring hanger pins.
8. Steel knuckle pins can be used in the manufacture of chisels.
9. The question of increasing size of shank and butt on couplers by welding on plates or pieces of iron is for comment.
10. Coupler parts other than knuckles should be picked out of the scrap with the idea of welding worn parts.
11. Iron knuckle pins, 1¾ inch, 1⅜ inch, 1½ inch, 1⅝ inch, can be manufactured from old rods or bolts.

	Class 24		
1	Canvas	Odd pieces can be used for patching	Upholstering shop
2	Carpets, old	Use for chair pads, patching or rugs	Upholstering shop
3	Curtains, old vestibule	Use in manufacture of engine cushions and caboose cushions	Upholstering shop
4	Hair, second hand	Clean and use over again in cushions, seats, etc	Nothing special
5	Linoleum, old	Use for patching	Nothing special
6	Moss, second hand	Clean and use over again in cushions, seats, etc	Nothing special
7	Plush, old	Use for patching	Upholstering shop
8	Springs, seat, old	Use in manufacture of cushions, seats, etc	Nothing special
9	Strip, metallic weather	Dispose of as scrap metal. Do not throw on the dump	
10	Tail gates, passenger car	Repair	Nothing specia'
	Class 25		
1	Bearings, ball	Electric headlight or train lighting. Regrind	Done by manufacturer
2	Electric headlight parts	Repair	Nothing special.
	Class 27		
1	Sacks, charcoal	Have a return value and should be reclaimed	
	Class 28		
1	Brick, fire	When removed from stationary boilers, use for patching in blacksmith shop. Can also be used as fire clay	
2	Crucibles, old	Have a market value. Save and report for sale	
	Class 29		
1	Axles, scrap	Upset and use for smaller size	Smith shop equipment
2	Axles, scrap	Turn down larger axles to smaller sizes	Lathe
3	Axles, worn outside collars	Build up by welding process	Welding apparatus
4	Axles, scrap	Work over and use in large variety of forgings, principal items being piston rods, crank pins, knuckle joint pins, follower plates, etc.	Smith shop equipment
5	Wheels, cast iron	Slid flat. Grind to standard dimensions	Wheel grinding machine
6	Wheels, rolled steel	Build up by electric weld	Electric welder
	Class 30		
1	Doors, grain	Ordipary repairs	Nothing special
2	Siding, old car	Utilize for inside roofing or for repairs on home cars or in manufacture of temporary coal doors	Nothing special
	Class 31		
1	Tools, cutting	Weld high speed steel on carbon steel for cutting edge	Smith shop equipment

12. Levers for patent release rigging can be straightened and nothing but broken levers should remain in the scrap.
13. Old metallic roofs should never be disposed of as scrap or thrown on the dump.
14. Care should be used to recover all usable oil box lids and parts.
15. Miscellaneous parts of friction draft gears easily find their way to the scrap dock, and should be recovered.

Class 21

1. Many journal bearings arriving in scrap yards could go back into service by slight skinning on proper machine.
2. Numbers of brass washout plugs can easily get into the iron scrap and should be watched.
3. Cracked locomotive bells can easily be welded.

CLASS 22

1. All rubber and leather gaskets not fit for reclamation should be kept picked up for their scrap value.
2. Triple valve and brake cylinder gaskets or leathers can be reclaimed by the use of castor oil, tallow and beeswax.
3. Any feasible scheme for reclaiming burst air hose is open for comment.
4. Air and steam piston heads can be turned down to smaller diameters.
5. Solid air pump piston rods made of high grade steel should be kept out of the scrap.
6. Triple valves should always be removed from broken or scrap cylinders and reservoirs.

ITEM NO.	CLASSIFICATION AND DESCRIPTION	OPERATION	EQUIPMENT REQUIRED
	Class 36		
1	Bases, smoke jack	Manufacture from old car roofing	Tin shop equipment.
2	Curtains, caboose	Renovate and re-use	Nothing special
3	Flags, signal	Renovate cotton flags and reissue	Ordinary laundry
4	Glass, colored	Has a market value. Hold and report for sale	
5	Goggles, safety	Repaired. Apply new parts needed	Nothing special
6	Lamps, various	Repaired	Tin shop equipment
7	Lanterns, hand	Repaired and re-tinned	Tin shop equipment
8	Lenses, colored	Have a market value. Hold and report for sale	
9	Replacers, car	If too low, build up by welding process to standard height	Welding apparatus
10	Tinware	Manufacture large variety from old metallic roofing. Empty powder cans make good dope buckets	Tin shop equipment
	Class 37		
1	Babbitt, from old refuse, oily waste packing	Burn old packing in order to reclaim babbitt	Nothing special
2	Compound, driving journal	Clean by boiling. Add necessary ingredients and reshape	Ordinary press
3	Compound, driving journal	Clean by scraping or other process. Reshape and reissue	Ordinary press
4	Oil, lubricating	Reclaim by filtering process	Necessary filters
5	Packing, journal box	Renovate and reissue	Steam heated tank, necessary filters, etc.
	Class 43		
1	Fittings, pipe	Remove all serviceable fittings from old pipe, and protect with coat of oil	Vise, vat, etc.
2	Nipples, pipe	Cut from second hand pipe	Nipple cutting machine
3	Unions, ground joint	Pick out various parts and reassemble	
4	Valves, Globe and angle	Repair	Nothing special
	Class 45		
1	Checks, door	Repair by using parts of old checks	
2	Files, over 6-inch	Save for recutting	
3	Hammers, engineers'	Manufacture out of scrap locomotive tire steel	Smith shop equipment
4	Wrenches, alligator	Recut teeth and retemper	Nothing special
5	Wrenches, screw	Repair by using old parts so far as practicable	Nothing special
	Class 46		
1	Belting, old rubber or leather	Use in manufacture of gaskets	Punch and dies
2	Boots, rubber	Repair	Cobbler outfit
3	Couplings, steam and dynamo	When worn, build up by welding process	Welding apparatus
4	Gaskets, steam hose	Unless broken or chipped, reface and apply gasket to make original height	Nothing special
5	Gaskets, tank hose	Manufacture from scrap air brake hose	Punch and dies
6	Hose, air, steam and signal	Strip and remount	Stripping and remounting machine
7	Lagging, Magnesia boiler	Break or grind up, form into slabs or use in mortar shape	Grinding machine, forms, dry kiln, etc.

7. Scrap valve stems made of high grade steel, pointed and equipped with wooden handle, make a very good screw driver.
8. Very few articles of air brake material should finally land in the scrap; parts of broken articles can always be utilized in repairs of others.
9. Parts of air gauges fit for repairs of other gauges should never reach the scrap dock.
10. Air pump lubricator glasses not cracked, chipped or broken, can be repolished and used over again

CLASS 23

1. Discs from bull's eye lubricators or flange oilers, not badly chipped or cracked, should be picked out and repolished.
2. Old water gauge glasses or discs can be reground.
3. Sand blast caps with small sand holes should be picked out of the scrap, as they can be easily welded.
4. No locomotive stocker material of any description should be disposed of in the scrap unless absolutely beyond repairs or reclamation.

CLASS 24

1. Old carpet should not be disposed of as scrap. It can be used for chair pads, patchings, rugs and similar purposes.
2. Care should be used in scrapping any steam heat parts, as there is big field for reclamation or repairs of such items.
3. Old gas tanks not fit for use with gas should be held out for storage of liquids.
4. Passenger tail gates should always be repaired and reissued.
5. Secondhand hair should never be thrown on the dump.
6. Care should be used in scrapping lighting material of any kind, as there is big field for repairs or reclamation of such parts..
7. Secondhand linoleum in pieces large enough for patching should not be sold as scrap or thrown on the dump.
8. Serviceable moss from cushions should be saved for cleaning and reissuing.
9. Coach curtain rollers should not be thrown in the scrap.
10. Secondhand plush should never be sold as scrap, but can be used for patching.
11. Secondhand coil seat springs should invariably be saved for use over again.
12. Old metallic weather strip, if beyond use, should be disposed of as metal and not thrown on the dump.
13. Old vestibule curtains should not be thrown in the scrap. They can be used in the manufacture of engine cushions and caboose curtains.
14. Couplings on Pintsch gas filling hose should not be scrapped with the hose.
15. Care should be used in scrapping any coach hardware. Parts of a broken article will often work in with another article requiring repairs.
16. Metallic bunks are always repairable and should not be scrapped for minor defects.
17. Any canvas fit for patching or for use in cushions should not be disposed of as scrap.
18. Tin shades should be used on caboose lamps in preference to opal.

CLASS 25

1. Old style steam and water glass lamps should be changed over to electric instead of ordering electric lamps.
2. Ball bearings for electric headlights or train lighting should be taken care of with the idea that they can be reground.
3. Exchange arrangements should be enforced on incandescent lamps, and inspection made of lamps turned back in exchange.
4. Electric headlight parts should not be left in the scrap unless obviously useless; headlight shafts can be welded.

CLASS 27

1. Charcoal sacks have a return value and should be properly taken care of.

CLASS 28

1. Old crucibles should never be thrown on the dump, but kept with scrap accumulation and reported for sale in regular manner.
2. Standard fire brick removed from stationary boiler locomotives can be used for patching purposes in blacksmith shops and groud for use as fire clay.

	Class 47		
1	Cans, empty carbide	Make various receptacles	Tin shop equipment
2	Kegs white lead, metal	Manufacture into paint buckets and similar containers	Tin shop equipment
3	Paint, old	Scrapings from barrels and other containers	Boiling vat
4	Glass, colored	Broken or unbroken, has a market value. Report for sale	
	Class 48		
1	Paper, scrap	Baled and sold	Paper baler
	Class 50		
1	Borings and turnings, brass	Remove parts of iron, steel or babbitt	Magnetic separator or screen
2	Firebox or boiler steel scrap	Use for running boards at stations	
3	Iron, scrap, various	Use for large number of miscellaneous forgings	Smith shop equipment
4	Staybolts, old, limed	Retain, rattle and clean, pile in furnace and use for forgings of various kinds	Smith shop equipment

CLASS 29

1. Small car axles can be provided by utilizing large axles, either by upsetting or turning down.
2. Worn outside collar on car axle can be built up by welding.
3. Flat spots can be welded on rolled steel wheels and tires.

CLASS 30

1. Attention should be paid to cuttings, etc., from planing mills and other accumulations or short pieces of lumber.
2. Ordinarily car stakes should never be manufactured out of new material.
3. It is possible in many cases to use secondhand siding for inside roofing.
4. Grain doors fit for repairs and use with grain should be properly taken care of.

CLASS 31

1. It is a recognized practice to weld a small piece of high speed steel on carbon steel for various cutting tools.

CLASS 36

1. Smoke jack bases and similar parts should as a general proposition be manufactured out of old metal car roofing.
2. Scrap burlap fit for the use in grain cars should never be disposed of as scrap.
3. Exchange arrangement should be enforced on caboose curtains, as these can be renovated and used over again.
4. Old brooms turned bake in exchange should not be burned or thrown on the dump. They can be issued for use on locomotives.
5. No tinware of any kind should get on the dump unless absolutely beyond repairs or reclaiming.
6. Exchange arrangement should be enforced on signal flags of all colors. Cotton flags can be renovated and used over again.
7. Welded ware can best be reclaimed by the old soldering process.
8. A large line of tinware can be manufactured from old car roofing.
9. No burners of any kind should be sold as scrap, as practically all can be reclaimed.
10. Cast steel replacers which are too low for standard rail can be built up by the oxweld process.
11. Cooler hose for hot boxes should be supplied from scrap hose released from welding equipment.
12. Fire hose couplings should invariably be cut from fire hose and not permitted to get in the scrap with the hose.
13. Colored lenses and colored glasses should never be thrown on the dump, as it has a scrap value whether broken or unbroken.
14. Old pressed steel wrecking frogs should not be scrapped unless badly broken or distorted.
15. No lamps of any kind should be thrown on the dump or disposed of as scrap unless beyond repairs. The serviceable parts should be removed.
16. Cab arm rest should not be thrown on the dump.
17. Large numbers of train indicator numbers are blown out and picked up on the right-of-way. These should be properly taken care of.
18. Wooden flag staffs fit for further use should not be improperly disposed of.
19. No hot box cooler parts which are fit for repairs of other coolers should get in the scrap.
20. Tank spout hooks, slash bars and clinker hooks should, if practicable, be repaired at local shops to save handling.

21. No serviceable switch chains or parts of same should get away in the scrap.
22. Effort should be made to recover as many paper car lines as practicable. Likewise such cooperage paper as is not torn or soiled.
23. Old bottles and jugs have a value and should not be thrown on the dump.
24. Buckets and dope cans can be made from empty powder cans.
25. Old cushions should be preserved and sent back to the upholstering shop.

CLASS 37

1. Old oil shipping drums beyond repairs and not fit for water barrels can be used for trash burner by removing the head and cutting a draft door at the base.
2. The matter of local reclamation of old waste calls for constant attention on the part of all concerned.
3. Wrappings from waste bales can be used in grain cars.
4. Waste used for wiping should not be mixed with journal box waste.
5. Wiping waste although not reclaimable, should not be thrown on the dump. It can be taken care of and used for lighting fires.
6. Empty carboys should be carefully handled, as they have a return value.
7. Driving journal compound should not be thrown on the dump. It can be cleaned and reissued.
8. Car oil sediment can in many cases be used in place of car oil.
9. Use of oil filters is an important proposition and should receive attention of all concerned.
10. The use of agitators in oil storage tanks is a subject for comment.

CLASS 43

1. Serviceable fittings should invariably be removed from scrap pipe.
2. Globe and angle valves should never get into the scrap, as they can be easily repaired.
3. Nipples should invariably be cut from old pipe.
4. Kewanee unions or similar unions or parts should not be scrapped until properly inspected, with the idea of reassembling and returning to stock.

CLASS 44

1. Wire reels have a return value and should be properly taken care of.
2. Carbon filament lamps should always be used where possible in places not requiring a higher priced lamp.

CLASS 45

1. No files fit for recutting should get in the scrap.
2. Steel knuckle pins should not be disposed of as scrap. They can be used in the manufacture of chisels.
3. Old files over 6 inches should not be saved for recutting.
4. Alligator wrenches, except when broken in the jaw, should be kept out of the scrap.
5. Engineers' hammers can be manufactured out of scrap tire steel.
6. Door checks, unless absolutely beyond repairs, should not be put in the scrap. Parts of same fit for repairs of other checks should be retained. tained.
7. Care should be used in scrapping latches or locks of any kind as quite often the lock or latch has parts which can be used in repairs of other articles.
8. Cellar keys should be kept out of the scrap.

CLASS 46

1. Steam hose gaskets, unless broken or badly chipped, can be refaced and by the application of a thin gasket can go back into service.
2. Worn steam and dynamo hose couplings can be built up by oxweld process.
3. Old asbestos removed from locomotives should never be thrown on the dump. It can be ground or broken up and used over again, either by forming into slabs or by using in mortar form.
4. Old rubber or leather belting and rubber cloth in pieces large enough for manufacture of gaskets should not be disposed of as scrap.
5. Scrap rubber gaskets of all kinds should be kept picked up for their scrap value.
6. Secondhand hose should invariably be used in place of new where there is no pressure involved.
7. No old rubber matting should be disposed of as scrap. It can be used on scale form.
8. Scrap rope can be used for tying up bundles, etc.
9. Tank hose gaskets can be manufactured from scrap air brake hose and the same machine used for punching rubber and leather gaskets.
10. Rubber boots should not be disposed of as scrap, as they can be reclaimed by cobbler's outfit.

CLASS 47

1. Paint buckets can be manufactured from old white lead containers.
2. Colored glass, broken or unbroken, has a valve and should not be thrown away.
3. Soda ash sacks have a return value and should be properly taken care of.
4. At points where acetylene gas is manufactured the refuse can be used to advantage in painting around the plant where white is desired.

CLASS 50

1. Fire box or boiler steel suitable for running boards should not be sold as scrap.
2. Hoops from waste bales will grade as light sheet No. 1.
3. Babbit from old waste should be properly taken care of by burning the waste and saving the metal.
4. Old rubber belting should not be disposed of as scrap, as it can be used in the manufacture of gaskets or for platforms on scales or runways of elevators.
5. Old style rubber fire hose should not be disposed of as scrap; it can be used in the manufacture of gaskets.
6. Brass foundry ashes have a value and should never be thrown on the dump.
7. No. 2 sheet scrap should be considered in connection with rip-rap purposes, particularly at times when this scrap is very low in price.
8. Destroyed steel cars should be disposed of without excessive cutting.
9. Do not scrap engine brake shoes unless the lug is broken or more than 50 per cent of the flangeway is worn off, for if the shoe is less than ½ inch thick in its thinnest part or if it is badly shelled out on the braking face or shows irregular wear, which would interfere with the hang on the wheel.
10. Babbitt should never be sold in the open market.
11. Do not scrap any car brake shoes which are ⅜ inch or over in thinnest part, providing that the eye and the steel back are intact, that there are no cracks on the braking face running lengthwise on the shoe and no large shelled out parts on the braking face.
12. Limed iron such as staybolts, regardless of length, braces, sling stays and similar limed iron can be piled and hammered into billets for forging work.
13. Waste paper should be watched as to cost of bailing, etc., as it sometimes does not pay to expend much labor on this article.

Discussion

J. C. Kirk (C. R. I. & P.):—If all of the railroads would reclaim all the different items that the committee has listed, the subject of reclamation would be very well taken care of. The cost of these different items should be watched constantly and the material should be tested. Then we can be sure that we are not wasting money by reclaiming material which should be scrapped.

I would like to refer also to the subject of welding frogs without removing them from the tracks. Do you weld before they are worn out, or do you simply weld when they are worn only slightly?

O. Nelson (U. P.):—This is determined largely by the roadmaster and the district roadmaster. The work has been very gratifying; in fact, we have run across cases where the claim is made that a built-up frog stands up better than new ones. On some roads they are regular floating gangs which cover the various divisions all the year around.

Mr. McGilligan (S. P.):—The Maintenance of Way Department on the S. P. builds up frogs, tracks and switch points. Where the rail is being superseded and we supply our requirements by reclamation.

R. M. Blackburn (C. & N. W.):—On the Northwestern track welding is done by the maintenance of way forces. On this reclamation work, I should like to ask if you take credit for the savings effected.

O. Nelson (U. P.):—It is handled differently on different railroads. On the Union Pacific we do. The information I have from the Southern Pacific shows their average cost for building up switch points was $5.15, and building up a 75-lb. frog, $24.46. The figures reached on the various roads on this work, running from $5 to $8 on the switch joints and $20 to $25 on the frogs, will give some idea of costs and savings.

Enough care cannot be taken to see that all material reclaimed is absolutely in serviceable condition before it is used. In regard to the cost of reclaiming, we have recommended for adoption this blank, which should be carried out rigidly and studied very thoroughly as to whether you are saving or losing money.

Mr. Wilton (B. & O.):—We have built up frog and switch points only on branch lines, but at Martinsburg we also repair motor cars, switch lamps, and all that class of material.

O. Nelson (U. P.):—Built-up frogs are standing up well. When we first started some difficulty was experienced in getting the right sort of steel. After six months of experimenting the right temper was obtained, and since then our frogs have been standing up splendidly. We are not, however, building up frog and switch points on our high speed main line tracks; the practice is confined to our branch roads.

J. G. Stuart (C. B. & Q.):—The real value of these frogs and rails after they are repaired has not been emphasized duly. On the Burlington we have a unique position in our stores department, inasmuch as we have charge of the frog and switch points as well as the rail end of it.

Mr. Mack (C. B. & Q.):—We have tested built-up frogs against new frogs under similar traffic conditions, with the result that the properly repaired or properly welded frog stands up in service fully as well as a new frog. We are of the opinion that in the majority of cases it is more economical to repair the frog out of the track. Better work is obtained when it is not done under traffic conditions. We also believe that not only is the quality of the work better when a frog is repaired out of the track, as compared with work done while in

the track. There are also certain costs incident to making the repairs in the track that are saved by repairing out of the track. We do not attempt to bring all frogs into a certain central point; we have established track repair shops at certain strategic points on the line; at our larger terminals. So far as possible we make them one-man shops. The welder, with a simple overhead hoist, can unload a frog from a car and also lift it back. That avoids the expense of a gang of men going to the shop to load or unload a frog. It seems to me that the big thing about reclaiming track frogs is keeping the frog in serviceable shape and condition while it is in the track. If bolts are permitted to become loose or to remain loose while the frog is in service, or if broken bolts are not renewed, the filler of the frog soon eats out and it cannot be repaired or tightened again so that it will remain tight. A beginning should be made with track forces, to keep the tracks and the frogs in the tracks in the proper condition. The frogs should be repaired before the points are beaten down and demolished and the rails cut to pieces. If that is done, enough will be made on repair of tracks, to make a good return on the investment.

A. W. Munster (B. & M.):—Except as a matter of education and information, I do not see where the service of supply has anything to do with the repair of frogs and tracks.

H. H. Laughton (Southern):—Some years ago, when we adopted oxyacetylene welding, we sent our switches and frogs to two points on the road for repair. The work was satisfactory except for the switch points. We have been using reclaimed switches and frogs on branch lines and in terminals for 10 years. About three or four years ago the engineering department and the maintenance of way department analyzed their costs and our costs, and they convinced me that 75 per cent of this repairing could be done in the track, and money saved, so we assigned them an operator and a car equipped with all the necessary tools and facilities. Each division now has a helper and an operator, who in most cases, were taken from the store department or shop, the expense being carried by the above departments. Each superintendent feels satisfied greater economy is obtained by not sending the work to the stores department.

J. G. Stuart (C. B. & Q.):—The stores department should not be sent out on the line. We have been doing this work at our reclamation plants. As soon as the practice is really developed, I think it should be sent to the department concerned. We have the talent for developing, and after that the work belongs to the maintenance of way department.

A. A. Goodchild (C. P. R.):—One item which to me has been a rather important one is the matter of cast iron wheels. I have corresponded with three or four of our general storekeepers, and the amount of money involved seems to me well worthy of our consideration. We used about 75,000 wheels on the Canadian Pacific and an estimate was made that 10 per cent or 20 per cent of the wheels removed could be reground and put into service again. Can we not have a special committee on reclamation work. I believe the subject is well worth the work of a special committee acting in conjunction with the mechanical department. Some of the roads doing this work, include the Chesapeake & Ohio, the Northern Pacific, and the Southern Pacific. The amount of money involved, should command our attention.

O. Nelson (U. P.):—Several roads are making it a regular practise to regrind wheels. It is simply a matter of opinion among the mechanical men as to the saving feature of doing the work. Those who have been doing it claim that large savings have been effected and that a wheel is better after it has been reground. They even claim that the ground wheel is less liable to cause hot-box than a new wheel, as it is truer and runs more smoothly.

C. D. Young (Penna.):—Of all our material in stores, 25 per cent is reclaimed material. I am of the opinion that in reclaiming material better results will be obtained by having all reclamation work done in a shop which has the proper equipment to do the work, that is, in the regular manufacturing shop. The independent reclaiming shops are not generally as well equipped as the regular shops. Therefore, although the committee has offered an exhibit of what might be possible in the way of reclamation plants, I believe that better results and lower costs will be had if we center all our manufacturing at our manufacturing plants. It is the duty of the stores department to select from the scrap, that which is to be reclaimed, and they then should turn it over to the process shops for remaking.

Section 29, offers three suggestions: Small car axles can be provided by utilizing large axles either by upsetting or turning down. I think before we offer suggestions of this kind to our Stores people, they should be referred to the proper committee of the Mechanical Section. The practical suggestion in No. 1 is not approved by the Mechanical Section. It is similarly the case with sections 2 and 3, namely: (2) Worn outside collar on car axles can be built up by welding; and (3) Flat spots can be welded on rolled steel wheels and tiers.

These two subjects are still mooted in the Mechanical Section. The principal of welding collars has been done by some roads and they have had trouble with it, and, therefore, I think we should go slow in offering to our stores people the suggestion that this should be done.

Vice President Reed:—Early in my Railroad experience I worked for a man whom I came to revere. He said to me one day: "Frank in going through life, don't fool the other fellow unless it becomes absolutely necessary; but under no circumstances fool yourself." We should not do what the mechanical or engineering departments are not posted on or we may be doing something that is wrong. I believe a large number of railroads today are dismantling and disposing of a lot of old equipment; some of them are turning them over to wrecking companies, to wreck them at a certain price per car, or they turn it over at a certain price per car. Some of those cars moved a long distance to get to these scrap yards and I understand that there is no effect being made on the part of the railroads that sell those cars to get the good material back. We can accomplish a great deal in that direction and save a lot of money for our company by watching this carefully.

Mr. Jones:—On page five, classification 1-B, article 9, track spikes, quick acting power hammer. We have discarded the hammer on the New York Central and have developed a machine for straightening track spikes. We are saving $20 a ton, actual figures, after adding one hundred percent overhead. We are actually doing the work.

Mr. Hyatt:—The one advantage of reclaiming by the stores department is that they are in a position to know what there is a demand for. There are a great many items mentioned here that it is possible to reclaim, but it may not be to a particular road's profit to reclaim. I think the man at the head of the reclamation should know the requirements, what is needed and take that into consideration for the entire railroad

The report was adopted and the subject continued.

(The following is the discussion of the Report on Purchasing Agents' Office Records, which report will be found at the end of this article.)

C. E. Walsh, chairman, presented the report and said: The National Association of Purchasing Agents, at Rochester, N. Y., approved the seventh tentative standard invoice form shown in the report.

Discussion

A. W. Munster (B. & M.):—I think it would be instructive if Mr. Walsh could tell us some of the principal factors that made up the Seventh Tentative Form.

Mr. Walsh:—The adoption of the invoice form was started by the National Association of Purchasing Agents and our committee heard about it and got in touch with them. They had several meetings and took it up with various manufacturers, had samples submitted and drew up this proposed form. Our committee felt it can be used by the railroad and that you can get anything you really want on that form. If we want to go along with the National Association we must give and take a little. The National Association of Purchasing Agents are going to put this over and if it is adopted it will save considerable money to the railroads. *The report was accepted.*

Scrap Classification—Handling and Sales

In view of the large amount of scrap material which must be handled and disposed of annually by the railroads, this work is of great importance and the committee report on the subject warrants the closest study. Particular emphasis is placed on problems of handling as related to scrap classification, and a plan of the Rock Island scrap dock at Silvis, Ill., included in the report, should have suggestive value for laying out new scrap docks or remodeling older ones. Durable and cheap docks are made from old car timbers properly tied together and filled with cinders. Labor is saved by locating storage bins adjacent to the sorting bins.

The committee report also includes a diagram of a smaller scrap dock of the Kansas City Southern, with the idea that a dock of these proportions will be better adapted to the majority of roads. In this case the unloading and sorting is done in a 42-ft. space reserved for that purpose at the center of the dock.

The Committee on Scrap Classification, Handling and Sales submits the following report in which the problems of handling are considered under two heads. The first is the necessity for gathering and disposing of scrap as governed by:

a. Cleaning the system from unsightly piles of old material.

b. Returning to use any serviceable material that may inadvertently have been scrapped.

c. Obtaining refund for or replacement of defective material before its guarantee has expired.

and shops, and by frequent inspections of these places, particularly under platforms, runways and inclines, at the rear of buildings, in lofts and attics, etc., scrap should be kept constantly moving towards the scrap yard or reclamation plant.

Section houses should be provided with bins about 8 ft. by 8 ft., made from old planking or second-hand ties, and as the accumulation is brought in, the serviceable items may be picked out and the small scrap placed in the bins. The larger pieces are placed beside in a pile, there to await the supply car or work train.

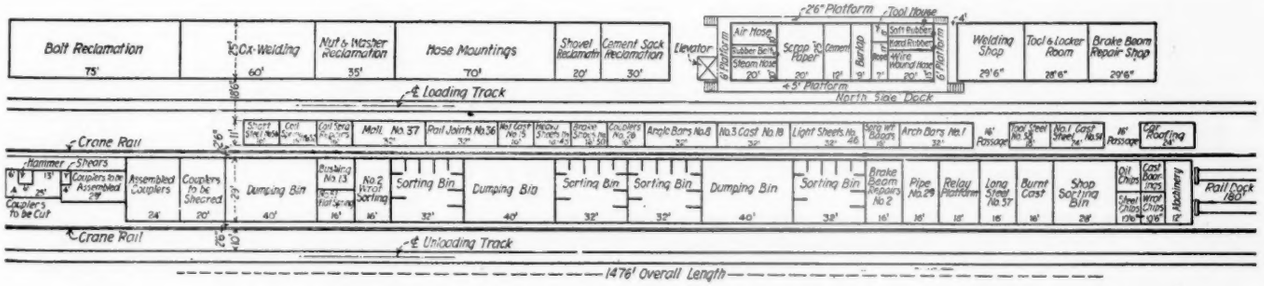


Exhibit A—Plan of Rock Island Scrap Dock at Silvis, Illinois, Showing Storage Bins Adjacent to Sorting Bins

d. Placing in the treasury the funds obtained for the sale of such material as may not be reclaimed or replaced.

To this end the efforts of all employees should be directed and periodical meetings arranged for at various points to call attention to the facts that:

a. A clean shop, storehouse and right of way make for safety.

b. The use of material until it is worn out is economy that reflects itself in a lower cost of operation.

c. The prompt movement of scrap into the terminals for disposal insures a movement of funds into the treasury.

The scrap movement begins at the section house, storehouse

Considerable material is turned in to the storehouse in exchange for new material issued; brass and other valuable metals are also sent back. This scrap other than metals should be taken care of on the storehouse platform convenient for loading; the metals should be placed in a locked box built for that purpose until such time as a box car can be loaded and properly locked, or, if at an outlying store, delivered to the supply car.

Bins should be built to meet the requirements at the different points. Borings and turnings should have a separate bin located conveniently to the shop so as to save labor in wheeling.

Bins should also be built to take care of the small scrap usually

made in the shops, and a space nearby such bins should be reserved for the heavy pieces. In each case the bins should be located as near as possible to the loading track in order to save extra handling. By the use of the bins inspection can readily be made by the men designated to look over the so-called scrap, in order to take therefrom good serviceable material or material that could be made serviceable with little labor or expense.

At the larger shops a tractor or power truck, with trailers, when not busy otherwise may be used to pick up the old material, and by having a loading platform with incline the gathered loads may be delivered to a car for shipment to the scrap yard. Where the accumulation is great enough the material may be partly sorted as it is being loaded without great expense, and the heavier scrap be kept together, as should also the borings and turnings.

Where the scrap yard and large shops are located at the same point, cars not suitable for road use could be properly placarded and placed in service between the loading platforms and scrap yard.

Material that is being returned for inspection and possible reclamation should be marked plainly with paint, and the consignor should write the officer in charge of the scrap dock giving the car number, waybill reference and approximate location of the material in the car so it will not be overlooked, getting the information to destination before car arrives. Any items that have been inspected at the point of origin and adjustment allowed should be plainly marked or painted "Scrap" so there will be no delay or double handling at the scrap yard.

It often happens that machinery is scrapped that may be placed in working condition and either used in the reclamation plant or sold to second-hand machinery dealers. All parts should be carefully boxed and missing or broken parts reported so that it may be placed for inspection at destination with a minimum of delay.

The ideal method of gathering scrap from points that do not accumulate in carload lots is by means of the supply train, as the trips are periodical and the crew becomes familiar with the scrap on the different divisions and is thus able partly to sort it. When exchanging new for old material any defects can be noted and the items held for inspection at the general store. When a car is loaded it can be released and forwarded direct, another empty being added to the supply train, thus not delaying a load.

All cars en route to the scrap yard should be loaded to a maximum tonnage and foreign line cars traveling in the direction of home should be given preference in this loading, care being taken also that there is no unnecessary delay in handling the equipment, as the per diem charge is a very large item of expense.

The largest tonnage is eventually sold as scrap (unless the reclamation plant is very extensive) and consequently the yard should be located at an advantageous point for disposal through sale, to avoid back haul.

The yard should have facilities for handling scrap and preparing it for the various classifications. Shears of proper size should be provided, and if impossible to have more than one, it should be large enough to cut a 6-in. axle and thus be able to care for what scrap may come in.

Docks are recommended, and to equip them properly a gantry-type crane is superior to the locomotive crane. A sketch of the dock at Silvis, Illinois (Chicago, Rock Island & Pacific), is shown (Exhibit A), and it will be noted that the storage bins are adjacent to the sorting bins. The docks are made of old car timbers tied together and filled in with cinders, and when properly constructed, should last for years. If any trucking is contemplated or

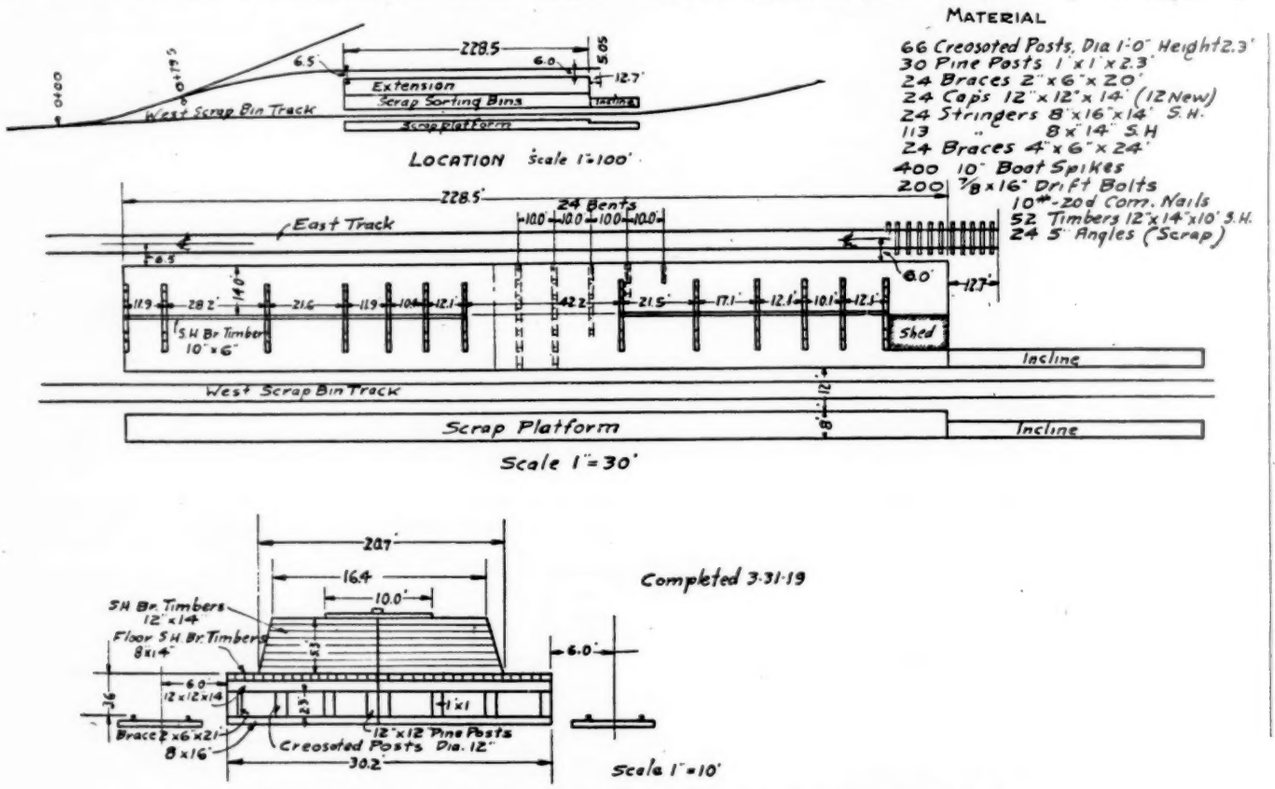


Exhibit B—Plan of Relatively Smaller Kansas City Southern Scrap Dock

wheelbarrows used, old boiler plate will make a smooth platform so that heavier loads may be handled.

The general scrap dock is equipped with three gantry-type cranes, two of ten-ton capacity and one of four-ton capacity. These cranes are equipped with electric magnets 52 in., 60 in. and 62 in. The claims for superiority over the locomotive crane are greater speed, larger loads and elimination of delays incident to switching. The docks are 1,476 ft. long and the cranes can reach every part of the dock, so if necessary to move a car the magnet can be dropped on its floor and the crane can then haul it to the new position.

The crane magnet unloads the scrap, the sorting is done by hand, and from the sorting bins the crane again picks up the sorted scrap for transfer to the storage bin. These are so located that cars can be spotted without conflicting with the unloading.

The work by hand has been reduced to actual sorting only and the movement of scrap by truck or wheelbarrow has been entirely eliminated.

The scrap rail is handled in the maintenance of way yard by a five-ton gantry crane equipped with magnet and controlled by one crane operator and one crane director. The magnet is 18 in. in

diameter, which permits the handling of one rail at a time, allowing inspection by the director as the unloading is being done.

Rail can be sorted by spotting cars for No. 1 and No. 3 rail at each end of the unloading car, and the No. 2 and No. 4 rail can be handled to the bins, the serviceable rail being placed at one side for inspection. At the Santa Fe yard, where the rail is handled almost entirely by a locomotive crane, one man in the car sorts the different classes before it is unloaded.

A smaller scrap dock is shown (Exhibit B) of the Kansas City Southern, approximately 228 ft. long and 30 ft. wide.

The center of the dock, about 42 ft., is reserved for an unloading and sorting bin. The dock approaches and platforms are equipped with rails set to standard gauge and an electric motor and hoist of sufficient capacity to pull a loaded push car of from two to four tons in weight is properly located, and as scrap is delivered from the shops it is pulled up and sorted into the bins directly from the cars as loaded by the shops, thus saving double handling. At the sorting bins there are two No. 5 electrically driven Canton alligator shears for disposing of larger pieces.

Material fit for reclaiming is placed on the second-hand material platform just west of the scrap dock, thus removing it from the scrap handling crew.

The two methods of gathering scrap are by means of push cars heavily built to hold about four tons, and "yard cars," old equipment stripped and fitted with 18-in. side boards to facilitate loading, these latter cars being placed at repair tracks, etc.

At this plant all scrap is handled by hand labor on docks, except bolsters, steel underframes, boilers, etc., this heavier material being handled on the ground by the use of a wrecking crane. There has been no difficulty in handling scrap in this manner, though the work may be delayed if the wrecker is being operated elsewhere.

The Oregon Short Line has two scrap docks, one at Pocatello, Idaho, fully equipped, the other at Salt Lake City, this latter limited to certain grades of scrap, all other grades being moved to the central sorting dock; this to accommodate market conditions.

The Denver & Rio Grande Western has two main docks also, one at Salt Lake City, the other at Pueblo. Where the tonnage warrants, loaded cars are shipped direct from shops to the customer, i. e., the Colorado Fuel & Iron Company, and their classification is greatly simplified in so doing.

Special bins are provided for borings and turnings, and considerable saving is claimed through the use of old fire boxes cut down and conveniently placed, which, when filled with scrap, are picked up by locomotive cranes and moved direct to the scrap docks.

The Santa Fe has one Brown hoist and four Industrial cranes, steam driven and equipped with electric generator and magnet, size 42 in., and is not now using docks. Its officials prefer the locomotive cranes to the gantry, as at the reclamation plant there is coal storage space and the locomotive cranes are equipped with buckets which unload or reload promptly and at a minimum expense. Twenty-five thousand tons of coal were handled during 1921. When not handling coal, cinders or sand, these cranes are used for unloading heavy material with chains, and they also do the switching when a switch engine is not handy, and have been used in construction work and in setting machinery.

The reclamation plant yard (about 250 acres) is wired and has water plugs conveniently placed so that the cranes can recharge and take water with very little delay. Coal bins are placed at loading and unloading tracks so that no time is lost in getting coal.

The scrap passes over a track scale on entering the yard, and is placed just south of the rolling mill and unloaded on the ground. The cars are then cleaned as they are being moved to the scale, and are again weighed light and if improperly stenciled this is corrected, an American Railway Association charge being made for this service where time limit has expired. This time limit is shorter on Santa Fe equipment than allowed under American Railway Association rules, and is covered by Transportation Light Weight Circular No. 29, as issued by the superintendent of transportation. No claims for shortage are allowed.

The sorters handle the pile from all sides, the serviceable material men who are experts in their line working with the scrap handlers to see that nothing goes in the scrap for sale that can be used or made useable. The scrap is wheeled to the various classified piles on old boiler plate runways by laborers.

All flat and round bar is sorted and kept separately to be sent to the rolling mill, where it is rolled into finished iron, which process gives a much better finished bar than if all No. 1 and No. 2 wrought were used, as was the custom formerly at outside mills.

The sorted piles are placed beside the loading track and loaded as the tonnage accumulates, so they are never high enough to cause extra labor. The tracks for unloading and for loading are parallel and are 500 ft. apart.

The scrap for sale is reported to the purchasing agent twice a month. By this method the accumulation is kept down and handling cost reduced. Certain classes of scrap, such as cast iron, brake shoes, and rail, are sold in the West. Wheels are handled direct from the shops, and the movement of empty home-bound foreign cars is used to carry the scrap to Chicago.

A portable overhead crane, known as the Aveling unloader, is claimed to have many advantages, as it moves on a track by its own power, and the magnet or clam shell passes through the framework, covering four tracks. It may be used for handling scrap, loading and storing coal, transferring loads from bad order cars, etc., and it does not require coal or water.

While gantry or locomotive cranes are not available the docks are still preferable, as heavy loads are more easily handled when they are level with the car platform.

Scrap as received from the line should be weighed in over the track scale, set on the unloading track, and immediately released. Where the car is clean and needs no repairs it may be reloaded immediately, thus making the service continuous.

Cars should not be loaded until they have been cleaned and light weighed, this to avoid possible claims for shortages, as stencil tare weights are not sufficiently accurate on which to base a refusal of short weight claims.

It is well to call attention to:

The practice of light loading cars. A maximum load tends toward economy in operation.

Proper repairs to cars to prevent loss.

Proper blocking of rail, wheels, etc., to prevent damage to equipment, shifting of loads, and consequent switching back to the yard for rehandling.

Thorough cleaning and light weighing of cars to prevent loss through claims.

Periodical inspection, cleaning and test of scales for the same reason.

Continuous movement of scrap in its destination.

Sale in advance on estimate of accumulation to keep the yard clear of material.

Immediate report of car numbers, weights, class of material, and forwarding of waybill to enable prompt collection for and disposal of loaded cars.

Prompt release of empty cars to avoid per diem charges.

Proper inspection of facilities so that needed overhauling may prevent a breakdown at an inopportune time.

A co-operation throughout all departments, from the section foreman and track gang up, to the end that a thorough knowledge that the main intention of scrap clean-up "Saving is earning" is understood.

Classification

In regard to the scrap iron and steel classifications, the committee's report at the last annual meeting held in Chicago, June 9 to 11, 1921, was further modified during the past year through discussion of several items that apparently conflicted and attention was called by members of the committee to the fact that while in general the classification as presented could be adopted, local conditions must govern various items.

It was proposed to include an item of shoveling steel, a classification that would take care of all small pieces of steel scrap such as tools and tool-steel, tie plates, number two wrought (when a road could not accumulate a carload), etc.

Prices were checked on tools and tool-steel, and it was found that there were times when this item commanded a premium.

Attention was called to the inclusion of punchings and clippings in Item 14, Busteling No. 1, and Item 31, heavy melting steel, and it was shown that the eastern mills would accept Item 31, heavy melting steel, with this material, whereas the western mills would reject cars containing it, and also that the inclusion of the clause, "No piece-weighing less than ten pounds," in Item 31 would eliminate this trouble for the western shipments and that the classification of shoveling steel would cover the small steel.

Item 28, flues and pipe. It was suggested that the words, "Free from galvanized material" be included.

Item 33, iron rail. The dealers present at the meeting reported that the consumers' classification called for 50 pounds and heavier,

and it was suggested that the matter be taken up with the rolling mills and an endeavor made to have them agree to lower their weight to 40 pounds.

Item 35, rail steel. Question of inserting a clause, "Badly worn flanges," was not passed on.

The question of inserting Items 42A, "Sheets from steel cars cut apart," and 43A, "Car roof sheets," is covered by the insertion of a note after Item 60 as follows:

> "Where a full carload of a special item that is included or could be included or mixed with other scrap is accumulated it should be reported separately and sold separately."

A suggested correction in the terms of sale was discussed and this clause was proposed:

> "Shipment will ordinarily be made within thirty days after receipt of shipping directions unless prevented by causes beyond our control. If shipment is not made within thirty days, prevented by causes beyond our control, notification of our inability to make shipment and the reasons for same should be communicated to the buyer, when he may, at his option, cancel the balance due. If the buyer does not immediately exercise this option, the contract remains binding to both parties."

No action was taken as to adoption of this clause as the old terms of sale specified forty-five days. The dealers at the meeting favored its adoption.

The Committee report is signed by: M. J. Collins (Chairman), Atchison, Topeka & Santa Fe, Chicago; L. V. Guild, Oregon Short Line, Salt Lake City, Utah; W. B. Hall, Denver & Rio Grande, Burnham, Denver, Col.; J. R. Haynes, Chicago, Burlington & Quincy, Chicago; C. H. Hoinville, Atchison, Topeka & Santa Fe, Chicago; W. F. Huneke, Chicago, Burlington & Quincy, Plattsmouth, Neb.; W. F. Jones, New York Central (East), West Albany, N. Y.; J. C. Kirk, Chicago, Rock Island & Pacific, Silvis, Ill.; A. W. Munster, Boston & Maine, Boston, Mass.; C. B. Hall, Pennsylvania System, Philadelphia, Pa. and S. B. Wight (chairman ex-officio), New York Central Lines, New York, N. Y.

APPENDIX

Scrap Classification

Terms of Sale

Please quote on this sheet price per unit specified on the following scrap materials. This scrap will be sold f. o. b. any point on our lines. Show in your bid tonnage and delivery point desired.

Sealed bids for this scrap, to receive consideration, must be in this office by 12 o'clock noon on..... and remain in effect until 12 o'clock noon on.....

Envelopes containing bids should be marked in lower left-hand corner "Bid on Scrap," and no change in your quotation will be permitted after that time.

The right to accept or reject part or all of your bid is reserved. If accepted, the following terms and conditions will govern, and will be made a part of the transaction.

Shipment

Final shipping directions must be furnished within five (5) days from date of award. When shipping directions for material are not furnished within five (5) days from date of award, it shall be optional with this company to cancel the sale at any time thereafter.

Shipment will ordinarily be made within thirty days (30) days after receipt of shipping directions unless prevented by causes beond our control. If shipment is not made within forty-five (45) days, prevented by causes beyond our control, it will be optional with either party to cancel balance due, within ten days thereafter.

Current tariff switching charges will be made for delivery to connecting lines.

Terms

Sight draft attached to bill of lading, or certified check before car is delivered. Our classification and track scale weights at point of loading to govern.

Please send your shipping directions to conform with above terms of sale.

Classification of Scrap Iron and Steel

(Quote price per net ton of 2,000 lb.)

Item No.

1. *Arch Bars and Transoms, Iron*
2. *Arch Bars and Transoms, Steel*
3. *Axles, Steel*—Car and locomotive, 6 in. dia. and over at center.
4. *Axles, Steel*—Car and locomotive, under 6 in. dia. at center.
5. *Axles, Steel, Hollow Bored*
6. *Axles, Iron*—Car and locomotive, all sizes.
7. *Angle and Splice Bars*—Steel angle bars and splice bars.
8. *Angle and Splice Bars, Patented Joints Only*.
9. *Angle Bars, Splices and Fish Plates, Iron*
10. *Boilers, Fire Boxes and Tanks, Uncut*—All kinds, attached or separate. Specify whether with or without flues.
11. *Boilers, Fire Boxes and Tanks, Cut Up*—Iron or steel boiler or tank plate cut into sheets and rings (with or without stay bolts.)
12. *Brake Beams, Uncut*
13. *Built Up Bolsters*
14. *Busheling, No. 1*—Iron and soft steel pipes and flues (free from scales); tank and bands No. 12 and heavier, boiler plate punchings and clippings, and soft steel and iron drop forgings and trimmings; nothing to be over 8 in. long or wide, free from galvanized or tinned stock.
15. *Cast, Railroad No.* 1—Pieces weighing 150 lb. or less, includes new grates, new stove plate and clean cast-iron culvert, soil and water pipe, to be free from brake shoes and burnt grate frames, burnt stove plate and all other burnt castings.
16. *Cast, Railroad, No. 2*—Pieces weighing over 150 lb. but not more than 500 lb., otherwise same specifications as class No. 15.
17. *Cast, Railroad No. 3*—Pieces weighing over 500 lb.; includes cylinders and driving wheel centers, and all other castings; otherwise same specifications as Class No. 15.
18. *Cast, Railroad No. 4*—All kinds of burnt castings, including grate bars, grate frames and stove plate.
19. *Cast, Iron Brake Shoes*—All shoes with steel back or with steel or wrought-iron inserts, both driving and car. Excludes composition filled shoes.
20. *Cast Iron Borings*—Clean and free from all other metals, dirt and lumps.
21. *Cast Steel, No.* 1—Charging box size, 5 ft. and under, 18 in. wide; no piece weighing less than 10 lb. to be included.
22. *Cast Steel, No. 2*—Steel castings over 18 in. wide and over 5 ft. long, may include cast steel truck or body bolsters and cast steel locomotive frames.
23. *Cast Steel Truck and Body Bolsters*
24. *Couplers and Knuckles, Steel and Steel nuckle Locks*
25. *Tools and Tool Steel*—Worn out steel tools, tool steel, files, including old claw bars, pinch bars, spike mauls, track wrenches, picks, adzes, axes, chisels, drills, hammers, knuckle pins, punches, finger pins, bits, draft keys, bar steel, weighing under 10 lb. per piece.
26. *Frogs and Switches, Uncut*—Steel and iron frogs and switches, that have not been cut apart, exclusive of manganese material.
27. *Flues, Tubes and Pipes, Wrought Iron and Steel No. 1*—1-inch dia. and over, 2 ft. long and over, free from fittings, paint, galvanized or enameled, coiled or bent material.
28. *Flues, Tubes and Pipes, Wrought Iron and Steel No. 2.*—Ungraded wrought-iron and steel flues, tubes and pipes, including fittings attached. *Free from galvanized material.*
29. *Limed Iron and Steel*—All kinds of material from interior of boilers (except flues which are encrusted with lime or corroded by the action of water) such as crown bars, crown bar bolts, stay bolts, etc.
30. *Malleable—All malleable castings.*
31. *Melting Steel, Heavy No. 1*—Charging box size, ¼-in. thick and over, and not over 18 in. wide, or over 5 ft. long, free of all attachments, may include chain, carbon tool steel, files, punchings and all other steel scrap that will come within the above dimensions, unless otherwise specified. *No piece weighing less than ten lb.*
32. *Melting Steel, Heavy No. 2*—All steel over 5 ft. long or over 18 in. wide.
33. *Rail—Iron No. 1*—Iron tee rail 3 ft. long and over, tee section 40 lb. per yard and over, free from frog, switch guard or crooked rail.
34. *Rail—Iron—Miscellaneous*—All iron rail not otherwise speci-

Item No.

fied, including guard rails, switch points and frogs, when cut apart. Does not include frog fillers or plates.

35. *Rail—Steel No. 1*—Standard section steel tee rails, 50 lb. per yard and over, 5 ft. long and over. Free from badly bent and twisted rails, frog, switch and guard rails and rails with split heads and broken flanges.

NOTE.—All rail suitable for relaying must be classified as Relaying Rail seperate from all scrap rail.

36. *Rail—Steel No. 2*—Cropped rail ends under 3 ft. long, 50 lb. and over standard section.

37. *Rail—Steel No. 3*—3 ft. long and over, 50 lb. and over, standard section having split heads or ball of rail worn with wheel flanges, curved and bent rails free from frog, switch and guard rails.

38. *Rail Steel No. 4*—All sections of rail not coming under specifications of No. 1, 2 or 3 rail, including frogs, cut apart, guard rails and switch points. Does not include frog fillers or plates.

39. *Structural Wrought Iron—Cut Apart*—Wrought-iron, structural, and shapes from bridges, buildings and equipment cut apart and free from riveted material.

40. *Structural Wrought Iron — Uncut*—Wrought-iron, from bridges, structures and equipment, which has not been cut apart.

41. *Structural Steel—Uncut*—All steel, or steel mixed with iron, from bridges, structures and equipment that has not been cut apart; may include uncut bolsters, brake beams, steel trucks, underframes, channel bars, steel bridge plates, frog and crossing plates and other steel or similar character not included in No. 2 Heavy Melting Steel Class 32.

42. *Sheet Scrap No. 1*—Under ¼-in. thick, consisting of cut stacks and stack netting, hoops, band iron and steel, pressed steel hand car wheels, scoops and shovels (free of wood), and wire rope; must be free from galvanized iron or tin, cushion and other similar springs and lime encrusted pipe and flues from boilers.

43. *Sheet Scrap No. 2 and Miscellaneous*—Includes netting, other than stack wire, all galvanized or tinned material, composition brake shoes and gas retorts, and any other iron or steel material not otherwise classified.

44. *Spring Steel No. 1*—Flat spring steel, including elliptic springs from which bands have been removed.

45. *Spring Steel No. 2*—All coils springs, made from steel 3/16-in. and over.

46. *Steel, Maganese*—To include all kinds of manganese; rail, frogs and switch points, cut or uncut.

47. *Steel, High Speed*—High speed steel turnings (butts and ends report separately).

48. *Tires No. 1*—All locomotive or car tires 36 in. and over inside diameter, smooth inside, not grooved for retaining rings or lipped.

49. *Tires No. 2*—All tires not included in Tires No. 1.

50. *Turnings and Drillings No. 1*—Wrought-iron and soft steel, clean, free from cast borings, brass, hard steel or other foreign metals, dirt or lumps.

51. *Turnings and Drillings No. 2*—From tires and other similar steel, including hard steel; clean, free from other metals, dirt and lumps.

52. *Turnings and Drillings—Mixed No. 1*—Wrought, cast and steel mixed, free from other metals, dirt and lumps.

53. *Turnings and Drillings—Mixed No. 2*—Wrought, cast and steel, mixed with brass and other metals, free from dirt and lumps.

54. *Wheels No. 1*—Includes all solid cast-iron car and locomotive wheels, no allowance for grease and dirt.

55. *Wheels No. 2*—Includes all kinds of built up or steel tired wheels. (Specify kind in offering.)

56. *Wheels No. 3*—Includes all solid rolled, forged or cast steel car and locomotive wheels. (Specify kind in offering.)

57. *Wrought—Railroad No. 1*—Clean wrought, pieces 6 in. long and over, flats to be ¼-in. thick and over; rounds or squares 3/8-in. thick and over; to include bars, rods, chain; all to be free from riveted material.

Item No.

58. *Wrought—Railroad No. 2*—All wrought, under 6 in. long, not specified under No. 1 Railroad Wrought; to include track spikes, bolts, nuts, rivets and lag screws.

59. *Wrought Iron Locomotive Frames or Mud Rings*—Includes all other large wrought-iron forgings.

60. *Destroyed Steel Cars and Locomotive Tenders*—Includes underframes and bodies of steel cars cut apart sufficiently to load—excludes trucks and cast steel underframes.

Note.—Where a full carload of a special item that is included or could be included or mixed with other scrap is accumulated, it should be reported separately and sold separately.

MISCELLANEOUS

61. *Aluminum*.

62. *White Metal No. 1*—Including various mixtures of clean bearing or lining metals, such as babbitt, metallic packing, etc.

63. *White Metal No. 2*—All non-bearing white metals, such as lavatory basins, exclusive of aluminum.

64. *Barrels*—Specify kind and with or without heads. (Standard Classification.)

65. *Bags and Burlap*—Bagging, sacking and waste covering.

66. *Brass, No. 1*—Locomotive bearings metals, such as driving, crown and rod brass, free from white metals, excluding car and tender bearings.

67. *Brass, No. 2*—Steam metal brass, including valves and fittings—injector and lubricating bodies and parts, and check valves.

68. *Brass, No. 3*—Journal bearings free from babbitt.

69. *Brass, No. 4*—Brass or bronze borings, drillings and turnings.

70. *Brass, No. 5*—Yellow brass castings, to include coach trimmings, light brass, hose couplings, pipe tubes, etc.

71. *Copper Cable, Insulated*—Specify kind.

72. *Copper, No. 1*—Wire free from insulation, flue ferrules, pipe and tubes.

73. *Copper, No. 2*—Sheet copper, sheathing and roofing, free from paint and nails.

74. *Copper, No. 3*—Sheathing and roofing copper, with paint and nails.

75. *Copper, No. 4*—Battery copper.

76. *Copper, No. 5*—Dross and oxide. (Report separately.)

77. *Canvas*—(Specify whether new or old.)

78. *Carpet, Linoleum, Plush and Rags*—(Specify kind.)

79. *Lead*—Sheet, pipe, etc.

80. *Lead.* Battery.

81. *Lead, Battery Mud or Sediment*—(Specify wet or dry.)

82. *Leather Belting*—No. 1 leather belting, 6 in. wide and over; No. 2 leather belting, under 6 in. punchings and trimmings; No. 3 rubber belting, all kinds; No. 4, composition belting.

83. *Rubber, No. 1*—Air brake and signal hose, free from wire and fittings; rubber boots and shoes without leather soles, rubber aprons.

84. *Rubber, No. 2*—All other hose, such as steam, water, tank, pneumatic tool, and washout hose, free from wire and fittings.

85. *Rubber, No, 3*—Rubber lined fire hose.

86. *Rubber, No. 4*—All wire wound and wire inserted hose, including oil and paint hose.

87. *Rubber, No. 5*—Rubber packing, gaskets, diaphragms, matting, step treads, etc.

88. *Rubber, No. 6*—Auto tires, solid and pneumatic, including tubes, free of fittings. (Specify material.)

89. *Rope*—Manila rope free from bow fenders.

90. *Tarrel Rope and Marlin*—Manila bow fenders, tarred rope and marlin. (Specify kind in offering.)

91. *Zinc, Battery or Sheet*—(Specify kind.)

The report was received and accepted as recommended practice.

Report of Committee on Supply Train Operation

The report deals with the subject of Supply Train operation in a comprehensive manner and contains many suggestions of value which may be applied in a practical way. The successful operation of a supply service on one railroad is made the basis of concrete recommendations for the establishment of similar service on other roads.

The committee outlines the method employed for the economical handling of materials and suggests many ways in which supplies may be distributed with least expense in train operation. The elimination of extra switching and overtime for train crews is an important item discussed in the report.

In the recommendations the committee has given consideration to all phases of supply service and has offered means for overcoming many annoying features of distribution of material.

DURING THE YEAR the committee has studied the subject of supply train operation and has observed the workings of the supply train on one large railroad. The economical results obtained by this method of handling materials and supplies are of such importance that the members should give the subject their personal attention and bring it to the notice of their executive officers.

To this report is also appended Exhibit A—a summary of previous reports which contain valuable suggestions and reasons why supply trains should be installed.

Exhibit A

Recommendations and Reasons For Operating Supply Trains

1. Essential features of supply trains are services of supply and delivering material to points where required for use.

2. Where an article is exchangeable, old article should be turned in at time delivery is made of new.

3. Basis of quantities of supplies to be delivered rests with originator of requisitions, subject to joint check on ground at time of delivery by the supply train operatives and the consignee.

North and South Railroad

SERVICE PERFORMED BY SUPPLY TRAIN

Divisions	Value of New Material Picked up Account Work Discontinued or no longer Needed	Value of Tools, Equipment and Serviceable Material Picked up and Brought in for Repairs	Value of Scrap	Total Credits	Value of Material Delivered to Stores, Car Shops and Engine Houses	Value Material delivered to others	Total Value of delivered to others Supply Trains	Per cent of Salvage by	Per cent of Car Days Saved

4. It is desirable to notify consignee in writing detail of items delivered at time delivery is made.

5. Where check of conditions on ground shows necessity of change in original requisition, correction must be made at time of delivery.

6. Under present conditions it is recommended a thirty-day schedule as most desirable.

7. New material not required on line, also scrap, waste paper, and obsolete material, will be loaded on supply train each trip.

8. The supply train be used wherever possible to eliminate work trains.

9. All company material of any nature, even in carload lots, should be delivered by the supply train when possible, and set out at stations or sidings where required, in order to eliminate the handling of same in way freights.

10. To make the operation of supply train most effective and result in maximum economy of the company maintaining, all unapplied material (including stationery) should be under control as to concentration, distribution, etc., of the General Storekeeper.

11. In order to properly inaugurate supply train on a railroad it is essential that practical men be directed to observe the operation of such practice or unit on some railroad where practice is in vogue.

12. In busy and congested territories, it is desirable that all company material which can be delivered through the medium of supply train be so handled, in place of handling through local freight houses and on way trains, which will lessen the congestion, eliminate car days, and congestion at freight terminals and freight houses. This method of handling will increase the car supply and add generally to service efficiency.

13. The following items to be delivered by supply train:

All of Maintenance of Way material, including frogs, switch points, switch stands, continuous joints, bolts, spikes, etc.

Less than carload lots of lumber, bridge and building hardware and material for assembled jobs.

Push, hand and velocipede cars.

Ware house and baggage trucks.

Mail carts.

Crossing and Right-of-Way signs, etc.

Distillate for Pumping Plants.

Gasoline for Section and Signal Maintainers' Headquarters.

Lime and Soda Ash for Water-Treating Plants.

Coal for Station Agencies.

Ice for use in Stations, Sections, B. & B. Gangs, etc. (where not contracted for local delivery).

All oils used in Signal, M. of W. and B. & B. Departments, as well as Pumping Plants and Station Agencies.

Miscellaneous material required for maintenance of Signal Department, Pumping Plants, Station Agencies, etc.

All small outside stores in supply train territory to be supplied, and all other sub-stores where possible.

14. It is further unanimously recommended that supply train service be extended and adopted on all railroads. We submit as a basis for this recommendation the following statements of cost of efficient supply train operation versus other methods. The savings brought about by good service have not been considered in these statements, as this element can not be computed in dollars and cents.

STATEMENT SHOWING COST OF OPERATING SUPPLY TRAINS

	Monthly
Labor at Stores in loading Supply Train	$500.00
Wages of Supply Train Storekeepers and Helpers	1,085.00
Personal expenses of Supply Train Storekeepers and Helpers and Store Department proportion of expense incident to performance of cook and living cars operated in connection with Suppy Trains	550.00
Charges from Transportation Department for wages of train and engine crews, round house expenses, and other incidental expenses; also fuel	4,700.00
Track laborers accompanying Supply Train	600.00
Total	$7,435.00

STATEMENT SHOWING ESTIMATED COST OF HANDLING BY LOCAL FREIGHT MATERIAL NOT DELIVERED BY SUPPLY TRAIN

Estimated cost of overtime to local trains and engine crews if material was handled by local freight	$3,280.00
Estimated cost of Local Freight Houses of handling, transferring and billing (on basis of 50 per cent of material passing through Freight Houses), at 57c. ton.	1,681.00
Estimated loss account material damaged or lost in transit, etc. (using as a basis 3 per cent of material delivered)	420.00
Estimated cost of picking up scrap and cost of handling, sorting, etc., at Division Stores, before shipping to General Scrap Headquarters, also overtime to local Freight Train and Engine Crews	2,500.00
Approximate cost of packing, tagging, loading, way billing, etc., at shipping stores	5,040.00
Stock on hand would have to be increased at all Division Stores approximately $160,000, if each had to provide for their Division requirements. Interest on investment at rate of 5 per cent per annum)	800.00
Estimated value of additional track tools, hand, push and and velocipede cars, which would be required on Line if no regular exchange system was in effect, $64,000. (Interest on investment at rate of 5 per cent per annum)	320.00
Estimated cost of motor car maintenance and operator for use of Watch Inspectors on monthly trip of watch inspection	255.00
Estimated cost of doing work by work train, such as distribution of ties, gravel, ice, sprinkling right-of-way with fuel oil, etc., which is now handled by Supply Train	1,125.00
Estimated cost of labor necessary to deliver material from Freight House to Section and Signal Tool Houses, B. & B. and Extra Gangs on Line, etc.	3,600.00
Total	$19,021.00

Appended hereto is recommended practice for the operation of Supply Trains.

15. A copy of this report has been sent to the Transportation Division of the American Railway Association, calling particular attention to the possibility of increasing car supply through the proposed methods of handling Company material.

16. In addition to the previous recommendations as to the operation of supply trains, it should be understood that on branches, or in territory where conditions do not warrant the operation of a train, the service should be modified and a regular supply car substituted—local supervision to determine frequency Such car to be accompanied by proper stores officer.

17. It is recommended that the attached form, showing Service Performed by Supply Train, be made standard practice where supply train service is inaugurated.

18. It has been demonstrated that the supply train can be operated sucessfully in congested territory and is being effectively operated on an eight track railroad.

19. One of the important results of the supply train is the reduction of stocks on line: Rail (new and second-hand) and scrap; switch ties; track fittings; frogs; cattle guards; emergency stocks; charged out stocks; all unapplied material; scrap. Also results in better care of material; consolidation of all material; joints; tie plates, etc., on each section at tool houses for monthly inventory and check by supply train.

20. The supply train makes for good housekeeping on the property.

21. The Committee feels that figures should be produced showing comparison on various railroads between the cost of distributing supplies under the former system, with supply train, but have not been successful in obtaining complete data on this feature.

22. The operation of the supply train is flexible, so that it can readily be adjusted to meet the requirements of a congested main line division, or a branch line with light traffic. As conditions change and demand for material falls off, the organization on a supply train can be reduced to one man, if necessary, and the disbursements reduced to such essential items as oil, switch and signal lamp supplies, etc. The saving in the distribution of oil alone by supply train as compared with the old method of distributing by local freight is worth the operation of a supply train regularly each month, and when business is light and purchases restricted there is even greater necessity of knowing what is disbursed along the road and gathering up surplus.

23. During the past year we have knowledge of three railroads that have installed supply trains, based on report of this Committee at our First Annual Meeting. The Committee has in its possession letters commenting on the efficiency and desirability of the service of the supply train for the information of any one desiring to review them.

Your Committee unanimously recommended the adoption of the following additional paragraphs to be added to our previous reports.

24. *Regular Schedule.*—To obtain the best results supply trains should be operated on a regular schedule each month or at other stated periods so that the men in the field will know postively when they will receive materials. During business depression when trains are curtailed and the men out on the line do not know when they are going to receive supplies, consequently they carry a considerable quantity in excess of requirements which leads to extravagant use of materials. This illustrates the necessity of regular operation of supply trains throughout the year and delivery of only the exact amount required for a stipulated period.

Exhibit B

STATEMENT SHOWING SERVICE PERFORMED BY SUPPLY TRAIN

	New Material Picked Up Account Work Discontinued or No Longer Needed.	Tools, Equipment and Serviceable Material Picked Up and Brought In for Repairs.	Value of Scrap Material Recovered.	Total.
Year—1920	$45,401.31	$232,079.71	$181,606.33	$459,087.35
Year—1921	73,950.84	284,008.22	137,387.76	495,346.82
Year—1922—2 months... Period, Jan. 1 to Feb. 28.	5,028.66	25,620.90	17,266.51	47,916 07

	Value of Material Delivered to Stores, Car Shops and Bunk Houses.	Value of Material Delivered to Others.	Total Value of Material Delivered by Supply Train.
Year—1920	$321,713.72	$1,255,173.08	$1,577,086.80
Year—1921	484,953.62	1,388,405.31	1,873,558.93
Year—1922 2 months' period, Jan. 1 to Feb. 28.	45,966.75	226,838.19	272,804.94

On railroads where a Supply Train is run in accordance with the plan outlined by the Committee, the use of such items as gasoline, lubricating oil for gasoline motor cars, spark plugs, axes and similar tools, coal for heating purposes, ice, electric light globes and stationary has been reduced so considerably as to cause lively interest of operating officials. It also often permits substitution of many items, thus avoiding the purchase of new materials.

25. *Elimination of Extra Switching and Overtime.*—Operating officials must soon give consideration to the delay to freight or peddler trains due to shipping materials by this method instead of by supply trains. When supplies are delivered by local freight, extra switching of cars is necessary for setting cars out at station. The delay incidental thereto means overtime to the train crews and must be taken into consideration in the cost of handling material by local freight service; overtime on locals means overtime for a crew of 6 men.

It is an everyday occurrence for a freight conductor to find shipments for points at the distant end of the line nearest the door, while those for the nearest stations are buried under masses of other materials that must be moved before delivery can be made.

The cost of a train crew waiting while this sorting process is going on is high. If a way-freight must lay at a station 45 minutes instead of ten minutes it is exceedingly expensive. This calls for systematic loading, but when company shipments are handled through two or three freight houses a condition like this will invariably follow.

Local train schedules are made primarily for commercial service, and in many instances, early morning, late afternoon, and night schedules are in affect. One purchasing agent, who formerly operated supply cars in local freight, stated to the committee that he knew of several stations and sections on the end of districts where agents and section foreman seldom ever saw the supply car, as invariably the local train handling the supply car was running all work so as to get in to a terminal and keep within the 16-hour limit. Material was thrown off by them on the run at night or carried in to the terminal and shipped back.

Cognizance must soon be taken of the waste and expenses not only of materials, but of other angles in the handling, shipping and delivering of material, which are sapping the finances of the railroads.

There is no reason why the supply train cannot eliminate all freight shipments except transfers between stores and emergency shipments. The entire demands of the Maintenance of Way Department can generally be taken care of by the supply train by 30-day delivery.

It is desired here to bring out the fact that the supply train, to get full economy, must get full utility—keep shipments off freight trains. This refers to switch ties, assembled jobs, tie plates, joints, bolts, spikes for rail laying jobs, frogs, switches and all the items incorporated in our previous report; work trains are thereby eliminated. This train must not be considered a supply outfit, consisting of an oil and tool car for light supplies. The committee has knowledge of one delivery by supply train of six cars of signal line poles, thus saving the expense of delivery by special work train.

26. *Inspection.*—The supply train facilitates inspections by officers who of necessity desire to keep in touch with matters on the line; such officers as Safety Agents, Claim Agents, Watch Inspectors, Water Service Foremen, Motor Car Repairmen, Scale Inspectors, Inspector Bureau of Explosives, Traveling Agents, Fire Inspectors, Sanitary Inspectors, Signal Engineers, Roadmasters, Trainmasters, Division Engineers, Assistant Superintendents and Superintendents.

27. *Approval of Requisitions.*—The supply train further abolishes the automatic approval of requisitions, which is a very important point, resulting in the heads of the various departments dictating to the individual what material is necessary to do his job, as compared with the old proceedure of indiscriminately signing requisitions at headquarters for what the individual may assume he needs.

28. *Investment in Unnecessary Stocks on Line.*—Where supply trains do not operate, large mileage of the railroad is unsupervised from material sense, therefore unnecessary stocks are accumulated. It is suggested that comparison be made between the value of material carried in section houses, tool houses, roadmasters' headquarters, etc., on roads that do not operate supply train versus roads which do operate them. It will be found that value of such material on hand will be greater by far on the aforementioned roads.

29. *Care of Article to be Repaired.*—The rough handling and consequent breakage and loss of articles handled by other methods than supply train is apparent—such items as markers, lanterns, tinware, etc. On supply train these articles are handled by experienced men, like articles are loaded together in specified cars and delivered to the actual shop where repaired, with a minimum of handling. It has been said with some truth that such material is more damaged by carelessness in handling than in actual use. When articles for repairs are shipped in pick-up cars they are often, if not always, destroyed by coming in contact with heavier materials; lantern frames are broken, costly lenses in marker and signal lamps destroyed.

Special appliances such as skids, unloading mats and air crane are part of the equipment of an up to date supply train, which insures delivery of material to the user in good condition.

30. *Safety First.*—The picking up of all dangerous tools at section tool houses and carefully inspecting all tools in use and charging out of same whether requested or not is a safety first feature which is made possible by the regular trip of supply train. Many a workman has lost an eye due to mashed head on a track chisel or maul. By lessening the number of handlings of material to get it to the point of use lessens the chances of hazard to the men, particularly in the handling of such heavy items as frogs, switches, switch ties, etc.

On some railroads safety meetings are held at terminals where supply trains tie up and safety supervisors and officers have an opportunity to meet the employees of that district. These meetings are bulletined in connection with supply train movements at terminals.

31. *Picking Up of Scrap.*—Another feature of unlooked for benefit and incentive in picking up scrap every 30 days was brought out recently where the railroad's maintenance expenditures are governed by monthly allowances. The roadmaster who turns in $10,000.00 worth of scrap gets credit for that amount, and can therefore use it in labor or materials, whereas if this material laid on the line he would lose that much, which in fact amounts to additional appropriation for maintenance for that particular month.

32. *Reducing of Correspondence.*—Frequently material is shipped by local freight, baggage, etc., and considerable correspondence is necessary, particularly when material is delayed and it is necessary to trace the shipment by letter or telegram, or ofttimes wrong material is requisitioned or shipped. This is avoided when material is handled by a supply train.

33. *Saving in Car Days.*—The necessity of eliminating car days is vital, particularly in times of car shortage and when perishable and other commodities are to be moved within a short period of time. The supply train reduces the use of such equipment to the lowest possible minimum. The same applies on car days on scrap picked up by cars drifting from section to section when these are handled by local trains, because two car days are necessary in each section and the switching incidental thereto.

Car day saved in drifting cars of supplies, etc., when handled in Local Freight versus Supply Trains. The committee has actual knowledge of the following delays:

On one railroad it was found necessary to cancel the trip of the supply train over a certain division after the train was loaded. The material to be delivered was shipped by freight, which resulted in 19 extra car days on one carload alone. In another instance 23 days were lost on a single shipment made by local freight.

General

There are so many savings possible to the supply train and so many costs largely concealed in the movement of material by other methods, that this committee has not had time or opportunity as yet to develop all of these costs in such a way as to satisfactorily present them, but we have in mind the following—for instance, a railroad may accumulate on the line 15,000 tons of scrap per year; has it occurred to General Storekeepers, Purchasing Agents and executive officers that the reclaimable material lying out on the line, if at hand, repaired and reconditioned, would save the purchase of similar new material at double or possibly triple the cost? This undoubtedly amounts to a large sum when we consider that on a railroad now following reclamation methods, reclamation and salvage has been shown to be close to $1,000,000 per year.

A question for this committee to consider is what percentage of the scrap material on the line is reclaimable; we must produce these figures to show concrete savings. The supply train covers the road every thirty days; under the old pick-up, catch-as-catch-can there must be double the amount of scrap and reclaimable material idle, which is not available or does not get the rapid turnover as with a supply train. Consequently it means greater deterioration and loss; in other words, the reclamation feature is retarded and in the meantime funds are expended for new material, when otherwise the money would be available for other uses.

In connection with the comparison of distributing material and supplies, by the old system of local freight, etc., vs. supply train, as recommended in paragraph 21 of Exhibit A, the Committee wishes to offer a suggestion for the benefit of roads not at present operating supply trains; in order to form comparison of cost between operating supply trains and delivering material by local freight, that each and every item entering into the cost of local freight delivery be enumerated, and cost compiled; for instance: cost of drayage of material to freight house; cost of handling; cost of billing; cost of unloading at destination; time expended in calling at freight station for material; cost of transporting scrap and old material back to headquarters, etc.

When local freight deliveries are made the investment in containers, drums, etc., for oils and other materials should be considered. *The supply train eliminates this investment.*

Attention is called to paragraph 17 in Exhibit A, recommending a form for service performed by supply train; as a matter of information we quote figures showing service performed by supply train on one railroad in accordance with that form—Exhibit B.

Recommended Practice For Operation Of Supply Trains

Accompanied by. The Supply Train should be accompanied by the Division Superintendents, Division Engineer, Signal or Assistant Signal Supervisor, Roadmasters, over their respective Districts, and Division Storekeeper.

The Division Officials use this train as a means of making regular inspection.

Requisitions. Requisitions for ordinary supply to be made up by the Roadmaster and others, and sent direct to the division Storekeeper for scrutiny as to proper description, etc., and they are then sent to the General Store from which Supply Trains operate.

It is not considered necessary to have Superintendent or Division Engineer's approval on these requisitions, inasmuch as they accompany the Supply Train, and the matter of what is to be furnished is investigated on the ground.

Requisitions for other Departments to be handled in a similar manner.

Any special requisitions, of course, should be properly approved.

Stocking of Trains. Supply Trains should be fully stocked to cover requirements, and carry some surplus to take care of such emergency requirements as have become necessary since the making of requisitions.

Filling of Requisitions on the Line. The night before starting each day's work, the Supply Train Storekeeper makes up unloading list by stations for the next day. This is made in triplicate, he retaining the original, one copy to his Helper, and the other copy to Division Storekeeper.

Between stations, Division Storekeeper checks over his copy of unloading list, determines the number and class of tools, etc., to be exchanged as well as the material which has been ordered.

On arrival at tool house, he immediately checks the amount of stock on hand, in most cases with the Roadmaster and quite frequently with the Division Superintendent and Division Engineer, and it is then determined whether or not the quantity ordered is over and above what is actually needed for 30-day period, or if the amount ordered should be increased. In either case the material decided upon is delivered and requisition is changed accordingly.

Exchange of Tools, etc. The exchange of tools and other exchangeable material to be watched very closely.

Track tools, in fact everything that can be exchanged, should be exchanged.

This system no doubt saves the railroad considerable money, as it eliminates abuses, also losses through theft, etc.

Oil Requirements. Schedules should be prepared whereby Division Storekeepers and Supply Train Storekeepers are in position to know just the quantity of illuminating and lubricating oils that will be required at the various points and by various departments, and no more than the schedule calls for to be delivered.

Picking Up of Scrap. All of the M. of W. Scrap accumulation to be collected and held at Section Headquarters for the Supply Train. The Signal, B. & B. Dept., Pumping Plant, Station Agencies, and others to handle scrap, obsolete, surplus and second-hand material in a similar manner.

Tools for Repairs. Tools for repairs are picked up by Supply Trains and brought into the Central Points, where all tools for the System are repaired.

The report is signed by: A. S. McKelligon, (Chairman), Southern Pacific Co., R. J. Elliot, Northern Pacific Ry.; J. E. Mahaney, Chesapeake & Ohio; J. P. Murphy, New York Central; J. L. Irish, Oregon-Washington R. R. & Navigation Co.; R. R. Jackson, Baltimore & Ohio; Wm. Shaw, Atchison, Topeka & Santa Fe; I. G. Morrison, Chicago, Burlington & Quincy; D. C. Curtis, (Chairman Ex Officio), Chicago, Milwaukee & St. Paul.

Moving pictures were shown in connection with this report there being no discussion.

Unit Piling of Materials and Numerical Numbering System

The action of this committee in making two distinct divisions of the subject under consideration will do much to prevent misunderstanding of just what is meant by Unit Piling of Materials and by a Numerical Numbering System. As clearly pointed out in the report, the first of these factors is vital in the control of stores department stocks so as to maintain a minimum investment in all classes of material. The numerical numbering system greatly aids in grouping, readily locating, and accurately accounting for individual items.

From the large number of replies received in response to questionnaire, it is evident that the title of the subject is misunderstood, and it was therefore decided by the Committee to consider the same in two sections:

Section 1. Unit piling of materials, dealing strictly with a system of uniform piling, and storing of materials, including the application of markers, showing the individual or accumulative count in each tray, bin or pile.

Section 2. Numerical numbering system, dealing with the subject of a standard designation or numerical symbol for each item carried in stock.

Section 1—Unit Piling of Materials

The paramount idea in railroad storekeeping today should be the control of stocks and a minimum investment in all classes of material. To carry this idea to a successful conclusion, a standard practice of storing and caring for material and supplies must be adopted.

Control of stocks is based on accurate stock book records, governed entirely by proper count and correct averages of monthly consumption. To obtain an absolute inventory of each and every item in stock, material must be piled to afford a ready count and also to bring about creditable decreases in cost of operation.

The committee therefore recommends the adoption of trays for the storing of material handled in shelving, which system permits the items to be piled in a neat, orderly and economical manner, provides a perpetual inventory and allows a ready inspection of such materials at all times. The trays to be equipped with numerical markers, showing the total number of items in a tray and the accumulative amounts in each tier of trays, these markers to be placed on all but the top or working tray.

It is further recommended that unit piling be followed out with every class of material. Lumber, castings, bars, sheets, pipe, flues, angle bars, tie plates, rail, etc., can be cared for in units, following as nearly as consistent tiers based on multiples of ten, placing between each tier a metal indicator showing the same accumulative count as used on trays in shelving.

The trays and markers can be made up entirely from scrap metal car roofing. The sheets are trimmed to size as needed, and layed out an inch or more longer and wider than the size required, to allow sufficient turn-up on all four sides.

The cost is negligible when compared with the labor previously used each month in removing and returning material to shelves, etc., in order to obtain a correct check and the expense of installation is many times offset by its advantages.

Conservation of storage space thereby reducing investment in additional racks and buildings.

The only system whereby material can be accurately and quickly inventoried for requisitioning purposes.

It induces better care of material and will unquestionably bring about better control and is no small factor in prevention of damage and deterioration.

It saves time to those delivering material on account of being readily available, and obviates the necessity of digging out the items as is often the case with material improperly arranged.

It eliminates unnecessary rehandling, and the cost of unit piling is not as great as the promiscuous handling or piling of material in some other manner.

Finally, for the psychological effect material well-cared for has upon store employees and users.

Section 2—Numerical Numbering System

The committee wishes to submit for study and consideration the numerical numbering system of marking materials. The basis to be a standard designation or symbol number for each item carried in stock.

Nearly all railroads arrange material under different groups, and each group carries a designating number.

However, there are thousands of items under each group that could be identified in some manner to avoid confusion. Section storekeepers handling one line of material become specialists, but they can not be expected to personally supervise the loading, unloading and storing of each item as it is received or forwarded, and it is for this purpose that the numbering system is offered for thought.

Two numbers are shown, the first represents the section or group, and the second, the item or symbol number. Articles large enough to carry a number have the same stencilled on each piece, small articles not large enough to carry a number are placed on shelving under labels showing description and symbol number. Price books and stock books show these numbers, and the same information is shown on all shop tickets, department invoices; and, in fact, on all documents handled through the store department appertaining to material issues and accounting.

The advantages to be derived are:

1. The prefix number enables the store forces to know under what group or section the material is carried.

2. The item or symbol number locates the record of the material and its proper place for storage.

3. The item or symbol number can be shown on shipping tickets so that helpers and truckers, who may not be familiar with the material, can select the correct material for filling a shipment and avoid delay.

4. The item or symbol number can be shown on shop tickets and when they are received in the office, the price clerk can readily locate the correct price shown by number, in price book.

While recognizing many good features in connection with this method, your committee does not feel justified in recommending it for adoption as a standard practice. We do feel, however, that it has sufficient merit to be worthy of further serious detail study, and it would be our recommendation, therefore, that the subject of numerical numbering system be referred to committee next year for further consideration.

The report is signed by J. L. Sullivan (chairman), Union Pacific, Omaha, Neb.; E. H. Landers, Cleveland, Cincinnati, Chicago and St. Louis, Beech Grove, Ind.; T. J. Hegeman, Chicago, Burlington and Quincy, Chicago; A. A. Taylor, Missouri Pacific, Little Rock, Ark.; F. E. Cragin, Los Angeles and Salt Lake, Los Angeles, Cal.; C. H. Thompson, Southern Pacific Co., Los Angeles, Cal.; V. N. Dawson, Baltimore & Ohio, Chicago Terminal, Chicago, and J. P. Murphy (chairman ex-officio), New York Central (West), Collinwood, Ohio.

This report was presented with lantern slides illustrating the different phases of the report.

Purchasing Agents' Office Records

The great number of transactions involved in buying the thousands of items which railroads use make it necessary to provide records which are as simple as possible and at the same time complete. Evidently it is sometimes difficult to harmonize these requirements, and the committee performs an important service in preparing forms for office records which represent the best practice based on the extensive experience of the members.

The work of the committee is complicated by the differences in methods used on various roads. In view of these differences, the recommended forms are not always applicable, but they are valuable as a basis from which each road can develop records to suit its individual requirements.

One important form in which standardization is very desirable is the invoice furnished when supplies are shipped. Such a form has been prepared by this committee working with other organizations interested, both on the railroads and the manufacturers, and is submitted with the report.

As indicated by the title, the committee on Subject 12, Purchasing Agents' Office Records, is supposed to recommend forms on which data in purchasing agents' offices is to be prepared or assembled and consequently it is necessary, in some cases, to show wording or instructions. As it would be difficult to recommend wording that would be applicable to all railroad purchasing agents' offices—because of different systems and methods in vogue—all should understand that the wording as shown on these recommended forms is a suggestion to be used as a basis only.

It is the unanimous recommendation of this committee that the forms, copies of which are shown, be considered standard, in addition to the forms already recommended:

(The forms are numbered to indicate the number of the subject, viz.: American Railway Association, Division VI—Purchases and Stores, Subject No. 12, Form No. 1, etc.)

Form No. 12-10-1—Request for Bids on Scrap;

Form No. 12-10-3—Award for Scrap;

Form No. 12-4-a, 4-b and 4-c—Scrap Sale Order.

Description of Forms

Form No. 12-10-1—Request for Bids on Scrap: Size 8-in. by 10½-in. The terms of sale to be the same as recommended by the Committee on Subject 10, Scrap Classification, Handling and Sales.

Form No. 12-10-3—Award for Scrap: Size 8-in. by 10½-in. The terms of sale to be same as recommended by the Committee on Subject 10, Scrap Classification—Handling and Sales.

Form No. 12-4-a, 4-b and 4-c—Scrap Sale Order: Size 8-in. by 10½-in. It is recommended that the triplicate copy be retained

A. R. A. VI P. S. 12-10-3

JOHN DOE
Purchasing Agent
SAMUEL SMITH
JOHN JONES
Asst. Purchasing Agents

NORTH AND SOUTH RAILROAD

OFFICE OF PURCHASING AGENT

.....19.....

Gentlemen:

We award you the approximate tonnage of scrap material, at prices quoted by you on our list dated....., as shown below:

TERMS AND CONDITIONS

(As recommended by Committee on Subject 10, Scrap Classification — Handling and Sales.)

Classification No.	Material	Tonnage	Price Net Ton	Delivery Point
	(Size recommended 8"x10½")			

Please furnish shipping instructions by return mail.

Signed).....
Purchasing Agent.

Form 12-10-3—Award for Scrap

in the purchasing agent's office, instead of the duplicate, although this may be handled by various railroads to suit their conditions.

It is also recommended that on railroads where the purchasing agent's office requires the information in column showing gross, tare and net weight, the copy retained by the purchasing agent's office be changed to suit the requirements.

Suggestions on Forms Previously Recommended

Form 12-7 and 7-a—Record of Purchases: (Adopted June, 1920.) Consideration was given to this form by the committee, and it was found that some roads were using a card form instead of the sheet, and it is recommended that it be left optional, with the railroads to use either a card or sheet form. It is also suggested that the sheets be numbered according to commodity, when additional sheets are necessary for the same commodity. Also that sheets be printed on both sides, if necessary. Size recommended 14-in. by 17-in.

General

The committee considered the advisability of recommending a requisition form, using as a basis the form adopted by Division VI, appearing in the Book of Rules for Railroad Stores Department Operation. Several representative general storekeepers were consulted, and the following result of the committee's investigations is given for information:

"1. The principal objection of the general storekeepers is to showing the quantity on hand, due and used monthly, claiming that this responsibility is theirs and that they are so closely in touch with the material requirements that they only should be held responsible.

"2. That if such information is shown it would likely be checked by some clerk in the purchasing agent's office who would have no knowledge of the use of material and might make changes in the quantities to be ordered that would result in serious delays to important work.

"3. That the information shown on the second sheet, or the storekeeper's sheet, is not sufficient and that additional records would have to be maintained, causing duplication of work.

"4. That the requisition form adopted by the American Railway Association, which is explained in the Book of Rules, known as Form No. 26, and the carbon copy, No. 26-A—retained by the storekeeper—carries a complete invoice record as desired by most roads.

"5. That instead of the committee adopting a new requisition form, its efforts should be confined to amending the present form, provided it is found revision is necessary."

Having given the matter considerable time and consideration, the committee recommends that the form adopted by the association be followed, because it is realized that this form carries all the information any railroad would desire, and that it is elastic as to its use; railroads not desiring all information could eliminate any portion not required.

The great trouble in arriving at a definite standard is because we have not all arrived at a uniform standard of storekeeping, and until the majority of railroads have reached this stage, it will be difficult to recommend a form that will be used extensively; the railroads are going to use a form that will meet their method of operations, regardless of the form the association might approve, and after going over Forms 26 and 26-A very carefully, keeping in mind the conditions as stated above, it is believed that nothing will be gained by recommending changes at this time.

For information, the reference relating to data on the requisition form, as shown in Part 2, Section 4 (h), American Railway Association Standard Book of Rules for Railroad Stores Department Operation, follows:

"(h) 'Data 1 to 5.'

"1. On hand.—This to be filled in by taking actual inventory of the item at the time the inventory is taken. Broken packages

A. R. A. VI P. S. 12-10-1

JOHN DOE,
Purchasing Agent
SAMUEL SMITH
JOHN JONES
Asst. Purchasing Agents

NORTH AND SOUTH RAILROAD

OFFICE OF PURCHASING AGENT

.....19.....

Gentlemen.

TERMS OF SALE

(As recommended by Committee on Subject 10.)
Scrap Classification — Handling and Sales.

JOHN DOE,
Purchasing Agent.

CLASSIFICATION OF SCRAP IRON AND STEEL

QUOTE PRICE PER NET TON

Classification No.	Description	Approximate Quantity For Sale	Approximate Quantity Desired	Price	Delivery Point Our Tracks
	(Classification as recommended by Purchases and Stores Division.) (Size recommended 8"x10½")				

(Back of Form 12-10-1)

Classification No.	Description	Approximate Quantity For Sale	Approximate Quantity Desired	Price	Delivery Point Our Tracks

The undersigned agrees to pay prices named for such scrap material as may be awarded, subject to terms and conditions stated on reverse side of this form.

Date of bid.....

(Signature)

(Address)

Form 12-10-1—Request for Bids on Scrap

or small amounts of loose material may be estimated and such other material estimated as instructed by the general storekeeper.

"2. Quantity Due.—This is the sum of all unfilled requisitions and of the balances due on partially filled requisitions.

"3. Holding Requisitions for.—Will include all unfilled items on all requisitions for issue or transfer to other stores.

"4. Used Last.....Days.—(The number of days desired as a working basis can be filled in to suit the conditions the store

is to work under.) This will be obtained from stock book by adding to the quantity ON HAND and DUE for the month.... .....days before the date of the inventory the sum of all orders on the purchasing agent, other stores, mechanical or other departments, and from the total deduct the amount on hand and due at date; the result to be entered in space provided.

"5. Surplus.—On this line is to be shown the amount of material on hand which is in excess of the amount ordinarily carried for stock or any material which is in excess of the number of days supply instructed to be kept on hand by the general storekeeper."

Also Part 3, Section 2 (i), follows:

"(i) Data.—Such data as desired by the purchasing agent, such as 1 to 4, part 2, section 4 (h), may be shown. If it is desired to show estimated cost, this column may be divided and space provided for the estimated cost. In case it is desired to show date wanted, if this column is not used for other purposes, this information may be shown here. In case this column is used for other purposes, this information may be shown in the 'Description of Material' column. Where purchasing department requires requisition reference on which material is due, additional space may be left in data No. 2."

TRIPLICATE A. R. A. VI P. S. 12-10 4c

JOHN DOE
Purchasing Agent
SAMUEL SMITH
JOHN JONES
Asst. Purchasing Agents

NORTH AND SOUTH RAILROAD

OFFICE OF PURCHASING AGENT

.....19....

Sale Order No.....

The following material has been sold to

Date of Shipment	Car Number and Initial	Gross Weight	Tare Weight	Net Weight	Date of Shipment	Car Number and Initial	Gross Weight	Tare Weight	Net Weight

QUANTITY	MATERIAL	PRICE	F. O. B. POINT

Ship from
Consign to
Route via

JOHN DOE,
Purchasing Agent.

Date of Shipment	Car Number and Initial	Gross Weight	Tare Weight	Net Weight	Date of Shipment	Car Number and Initial	Gross Weight	Tare Weight	Net Weight

TRIPLICATE to be placed in the hands of the party loading the material.

Form 12-10-4c—Scrap Sale Order

Numbering of Requisitions

While the committee understands thoroughly that they are supposed to confine their work to purchasing agents' office records, they did not think it out of order to call attention to the method of numbering requisitions used on some of the railroads whereby the classification or account number is shown so that when an inquiry is made of a purchasing agent's office for information in connection with a certain requisition, the classification or account being included in the number facilitates the location of papers, etc., in connection with same. As an illustration, requisition No. 06121 would be a requisition prepared in the month of June, account 12, first requisition. The second requisition for that account would be 06122. Ciphers are used where there are less than two numerals, for example, for the month of June, in account 6, the number would be 06061, and the second requisition would be 06062, etc. The first two numerals (or digits) indicate the month, the second two the account or classification, and after that the number of the requisition as prepared.

In addition to this, some of the railroads use letters, as symbols before the requisition number to indicate the store or requisitioning point. This system has been found to work very satisfactorily with purchasing agents' offices that file their orders by accounts rather than numerically or alphabetically; also where the requisitions are filed by accounts rather than numerically or by requisitioning points. Some of the railroads have even gone so far as to use the same number for their purchasing agent's order number.

Form 12-5 Invoice Form

As instructed at the 1921 business meeting, the committee has considered a standard invoice form, to be furnished by the sellers, in conjunction with the Railway Accounting Officers' Association and the National Association of Purchasing Agents. Representatives from these associations attended one of the committee's meetings and the form was thoroughly discussed, and it was decided that a joint conference should be held with a number of representative dealers, the Cost Accountants' Association, the National Association of Purchasing Agents, Railway Accounting Officers' Association, National Lumber Manufacturers' Association, Window Envelope Manufacturers and others interested, in order to obtain a broad view of this important form and to arrive at a standard suitable for use by all concerned, and one which the railroads could adopt.

The chairman and assistant secretary attended this conference and a copy of the proposed form, marked "Seventh Tentative

DUPLICATE A. R. A. VI P. S. 12-10 4b

JOHN DOE
Purchasing Agent
SAMUEL SMITH
JOHN JONES
Asst. Purchasing Agents

NORTH AND SOUTH RAILROAD

OFFICE OF PURCHASING AGENT

.....19.....

Sale Order No.....

The following material has been sold to

BILL Date	BILL No	BILL Amount	Date B-L	Net Weight	Car Number and Initial	Amount		Date Received	Date Forwarded

QUANTITY	MATERIAL	PRICE	F. O. B. POINT

Ship from
Consign to
Route via

JOHN DOE,
Purchasing Agent.

BILL Date	BILL No.	BILL Amount	Date B-L	Net Weight	Car Number and Initial	Amount		Date Received	Date Forwarded

Form 12-10-4b—Scrap Sale Order

ORIGINAL A. R. A. VI P S. 12-10 4a

JOHN DOE, Purchasing Agent
SAMUEL SMITH
JOHN JONES, Asst. Purchasing Agents

NORTH AND SOUTH RAILROAD

OFFICE OF PURCHASING AGENT

.....19...

Sale Order No.....

The following material has been sold to

Send to Purchaser, Memo. giving date of shipment, contents of car, car number and initials, gross, tare, and net weights.

Send direct to the undersigned by first mail after the material has been loaded, itemized bill in triplicate, with bill of lading in duplicate attached.

Refer on invoice to above number of this sale order, and show sale order number and F. O. B. point on bill of lading as authority for deadhead movement to point of free delivery.

Do not use stenciled tare weight. Before loading scrap, see that all foreign material is removed from the car, then have the car light weighed in order to obtain actual tare weight, and weigh loaded car on the same scale.

Keep separate different kinds of scrap if loaded in same car.

QUANTITY	MATERIAL	PRICE	F. O. B. POINT

Ship from
Consign to
Route via

Purchasing Agent.

ENTER SHIPMENTS HERE FOR YOUR RECORD

Date Bill	Date B-L	Bill No.	Car Number and Initial	Gross Weight	Tare Weight	Net Weight	Amount	

Form 12-10-4a—Scrap Sale Order

Standard Invoice Form," is submitted with the recommendation that it be approved by Division VI and the National Association of Purchasing Agents so advised.

The report is signed by Charles E. Walsh, (Chairman), Pennsylvania System (Central Region); G. W. Bichlmeir, Union Pacific; W. C. Bower, New York Central; C. R. Craig, Southern Railway; L. Lavoie, Canadian National; J. F. Marshall, Chicago & Alton; S. W. Saye, Georgia & Florida; F. W. Taylor, Southern Pacific; E. G. Walker, Atchison, Topeka & Santa Fe and W. G. Phelps, (Chairman Ex-Officio), Pennsylvania System (Central Region).

(*Discussion on this report will be found on page 1665.*)

A Correction

IN THE DISCUSSION of the locomotive headlight report in the *Daily* of June 20 a statement was ascribed to Mr. Castle of the New Haven. There is no such person, and moreover the reporter got a bit mixed up on what was actually said.

It was J. C. Hassett, mechanical engineer of the New Haven who really took part in the discussion, and regarding the last paragraph of his statement, what he did say was: "The last item that I wish to mention is the 3/8 in. bolts securing the headlight casing. These bolts are too small when it is considered that the effective diameter is at the root of the thread only and *climatic* conditions, particularly in the New England states, will soon start corrosion and it may be expected the bolts will fail and only too soon. These bolts should be of a larger diameter."

C. E. Chambers, superintendent motive power and equipment of the Central Railroad of New Jersey, has been appointed chairman of the Tank Car Committee, succeeding A. W. Gibbs. Mr. Chambers has served on this committee for several years.

Seventh Tentative Standard Invoice Form

embodying constructive criticisms of present forms received by

THE NATIONAL ASSOCIATION OF PURCHASING AGENTS

19 PARK PLACE, NEW YORK

Customer { Ord. No. & Date / Requisition No. / Contract No. / Shipped to / Destination

Terms

To be written or printed here.

Date shipped
Car No. and Int.
How Shipped and Route

Invoice date
Invoice No.
Shipper's Order No.

Name and address of customer to whom invoice is to be mailed may be put in this space.

From F. O. B.

This column reserved for use of customer.

P. A. Invoice No.
Voucher No.
Checked { With order / F. O. B. point / Price / Calculations / Transportation / Trans. Chgd. back

DESCRIPTION	QUANTITY (Show Unit)	PRICE Per Unit	AMOUNT

Committees from the following organizations have co-operated in the development of this form.

The National Association of Purchasing Agents.
Disbursement Committee of Railway Accounting Officers Association.
National Association of Cost Accountants.
Div. VI Purchases and Stores of the American Railway Association.

Line spacing may be suited to machine or hand writing maintaining same relative positions. Sheet 8 1-2 inches wide and not less than 7 nor more than 14 inches long.

Four top lines to be replaced by shipper's name and address. Form may be moved down if more space is needed for shipper's name. A tolerance of 1-8 inch in either dimension is contemplated. Invoices longer than 7 inches to have dots or short rules printed on sides 7 inches from top to indicate point of fold for filing.

Certain blank spaces such as "Shipped To," "Destination," "Invoice No.," "Contract No.," "Car No." etc. are intended for use when such information is required to identify a shipment.

Above Materials received .....192.. .and same is.....satisfactory (Signed).....(Title).....

Charge Account Approved Approved

Proposed Standard Invoice Form

Registration Today

THE COMPARATIVE registration figures for 1922 and 1920 speak for themselves. There are more members of both the Mechanical and the Purchases and Stores Divisions present than in 1920. This is also true of the special guests and the railroad ladies. There are fewer supply men and supply ladies in attendance than two years ago. The totals show a good gain for this year—in fact, exceeds all past records.

	1922	1920
Div. V—M. M. and M. C. B.	999	875
Div. VI—Pur. and Stores	376	364
Special guests	907	785
Supply men	2,290	2,575
Railroad ladies	1,008	798
Supply ladies	573	676
Totals	6,153	6,073

From a Baseball Fan

To the Editor:

There is considerable agitation abroad for a revival of the old-time baseball game on Saturday afternoon of the 1923 convention, the teams to be composed as in past years of members representing the East and West. Every player should be a bona fide member of at least one association and not be merely a good player from a shop or one of the Saturday afternoon leagues.

If the game was called at 4 p.m. and lasted two hours it would give ample time to visit the exhibits on Saturday. A number of the "old guard" have expressed themselves forcibly on this subject. Convention visitors who are interested should write the president of the R. S. M. A., or Secretary John D. Conway.

B. B. Fan.

Boiler Tube Practice

THE METHODS of applying and maintaining locomotive boiler tubes have not changed in any of the essential features for many years, but the subject is so important that it is always of interest. The practices on different roads are by no means identical. Realizing this fact, the Parkesburg Iron Company, Parkesburg, Pa., recently prepared a booklet giving approved methods for the application and maintenance of charcoal iron boiler tubes, which is being distributed at the convention. The subjects covered include the application of boiler tubes, super-heated flues and arch tubes, and the welding of tubes and flues. Instructions are also given for maintaining tubes at roundhouses and for handling flue shop work. The booklet is of interest to officers of the purchasing and stores departments as well as to mechanical men, one section covering the ordering and storing of tubes and flues. One of the interesting features of the book is a suggested form for recording the service obtained from locomotive boiler tubes.

Registration, American Railway Association

Division V—Mechanical

Abbott, R. B., Asst. Gen. Supt., P. R.
Armstrong, W. S. F., Insp., B. & O., Haddon Hall.
Arter, W. D., Sup. Apprent. M. P. Dept., N. Y. C., Arlington.
Bachman, J. H., M. P., Penn.
Balthaser, Wm. B., Road Fore. of Eng., P. & R.
Barr, P. W., Gen. Fore., Penn.
Barry, J. J., G. M. M., N. & W., Brighton.
Bartlett, A., Air Brake Insp., Penn., N. Y. Div.
Bowes, L. C., Supvr. Stat. Plants, C. R. I. & P., Ambassador.
Brown, P. M., Engr. M. P., N. Y. C., Marl.
Voelker, H. R., Asst. M. M., Penn., Craig Hall.
Walter, Louis J., Gen'l. Fore., C. R. R. of N. J., Sterling.
Weaver, C. W., Asst. Engr. Fore., Penn., Haddon Hall.
Wiley, C. H., M. M., Indian. Union, Kentucky.
Williams, Irvin, Asst. M. M., Penn.
Williams, M. E., M. M., P. & R., Sterling.
Willis, Jos., Conductor, Penn.
Yeoman, Geo. C., Con. Engr., Traymore.
Young, C. D., Mech. Dept., Penn., Brighton.

Division VI—Purchases and Stores

Armstrong, Geo. W., Spec. M. Rep. Stores Dep., Erie.
Baldwin, C. D., P. A., Bangor & Aroostook.
Benche, Louis V., Stationer, P. & R.
Boice, C. D., Secy. & P. A., F. E. C., Galen Hall.
Buskey, C. A., Store., N. & W., Princess.
Cain, J. W., Mgr. Pur., Am. Short Line R. R. Assn.
Cherry, C. P., Trav. Store., Penn., Blackstone.
Corbin, A. B., Store., Penn., Iroquois.
Crowley, M. D., Trav. Store., N. Y. N. H. & H., Edison.
Deery, James, Asst. P. A., Penn., Traymore.
Dell, F. S., S. K., Penn.
Doran, A. B., Insp. Dept. Mat. & Sup., U. S. R. A., Fredonia.
Edgell, T. S., Store., M. & C., Princess.
Ehrhart, E. D., Lumber Agt., Penn., Princess.
Ellenberger, E. G., Store., Phila. Div., Penn., Pennhurst.
Eudy, Wm. N., Store., P. & R.
Euscoe, J. R., Supt. Rec., N. Y. N. H. & H., Pennhurst.
Farraday, C. L., Con. Mat. Agt., Penn.
Ferguson, W. J., Asst. Chf. Clk., Penn.
Fitzgerald, W. F., Asst. P. A., D. & I. R., Strand.
Foley, F. I., Asst. to Gen. Store., N. Y. N. H. & H., Freedmore.
Follette, A. G., Sup. Stores, Penn.
Fowler, J. B., Store., Penn., Blackstone.
Frank, D. E., Store., Phila. Div., Penn., Pennhurst.
Fritz, Wm. F., Mat. Clerk, Penn., Blackstone.
Fulmer, Walter W., G. P. A., Amer. Ry. Exp. Co., Glaslyn Chatham.
Gann, J. C., Insp. of Stores, M. P., Breakers.
Given, W. J., Dist. Store., M. & O., Traymore.
Glenn, Daniel C., Store., P. & R.
Gowland, S. I., Asst. Gen. S. K., Penn., Silverside.
Grammer, P. L., Gen. Agt., Penn.
Green, L. J., Asst. Gen. Store., N. Y. C.
Hall, C. B., Asst. to Gen. Purchas. Agt., Penn., Hadden Hall.
Hanna, J. L., Gen. Supv. of Stores, Penn.
Harte, E. P. G., Asst. to Gen. P. A., Seaboard Div.
Haynes, Walter H., Stores Insp., P. & R., Chester Inn.
Hughes, Edward, P. A., L. & N. E.
Johnson, P. E., Asst. Gen. Store., B. & O., Shelburne.
Johnston, J. M., Gen. Fuel Agt., M. K. & T., Traymore.
Jones, Edward, Asst. to Gen. Pier Agt., W. M., Schlitz.
Juley, E. C., Store., G. B. & W., Traymore.
Keating, N. M., Div. Store., N. Y. N. H. & H., Pennhurst.
King, W. H., Jr., G. P. A., S. A. L.
Kirk, J. C., Asst. Gen. Stkrs., C. R. I. & P., Traymore.
Knauer, W. R., Asst. Sup. Stores, Penn.
Krampf, L. P., Asst. to Supply Agt., M. P., Breakers.
Landers, E. H., Genl. Store., C. C. C. & St. L. Ry., Traymore.
Landis, J. D., P. A., Reading.
Lavoic, Louis, G. P. A., Can. Nat. Rys., Haddon Hall.
McCann, Thos., Store., P. & R., Alamac.
McKelligon, A. S., Gen. Store., S. P., Traymore.
McNeal, B. D., Store., Penn. Iroquois.
McNichol, Bernard I., Store., P. & R., Philadelphia.
McQuilkin, H. P., Gen. Store., B. & O., Shelburne.
McTighe, J. F., Store., Lackawanna, Bothwell.
Marshall, C. A., Div. Store., B. & O., Traymore.
Marshall, J. F., P. A., C. & A., Traymore.
Merritt, Walker H., Store., B. & M., Colonial.
Middleton, T. R., P. A., Cumber. & Penn., Breakers.
Morris, William H., Asst. Gen. Store., P. & R.
Nevmann, B. A., Store., Penn., Blackstone.
Nicholas, E. L., Store., Penn., Blackstone.
Oswalt, W. L., Jr., Asst. Works Store., Penn, Elberon.
Otto, C. A., Equip. Agt., Penn.
Owen, A. E., Asst. to P. A., Penn., Strand.
Painter, C. R., Asst. to G. P. A., N. Y. N. H. & H., Strand.
Page, W. L., Trav. Store., Southern, Breakers.
Pembleton, H. V., Div. Store., N. Y. N. H. & H., Princess.
Phillips, J. P. H., Act. Lbr. Clk. P. I., Penn.
Portlack, W. M., Gen. Store., S. A. L.
Powers, M. J., Genl. Store., Ulster & Del., Princess.
Price, E. H., Gen'l. S. K., N. Y. N. H. & H. Traymore
Rainie, Harrison M., Trav. Store., B. & M., Colonial.
Reichle, A. C., Material Agt., Penn., Ambassador.
Remenayder, E. J., Off. Asst. P. A., Penn.
Reyno, E. R., Asst. Store., Penn.
Rice, N. M., G. P. A., N. H., Traymore.
Robinson, G. H., P. A., O. W. R. & N., Traymore.
Ruston, Wm. E., Store., B. & M., Colonial.
Saabye, H. J., Asst. Purcha. Agt., B. & M., Shelburne.
Saye, S. W., P. A., Georgia & Florida, Traymore.
Schneider, C. H., Dist. Store., C. R. I. & P., Traymore.
Schuetz, L., M. W. Store., Penn.
Scudder, C. J., S. S., D. L. & W., Chalfonte.
Secor, C. A., Genl. Store., C. & A., Traymore.
Seith, Harry, Store., N. Y. C. & St. L., Alamac.
Smith, C. Edward, Insp. of Stores., Penn., Ambassador.
Stevens, M. W., Div. Store., G. T., Esplanade.
Stout, Henry D., Store., Penn.
Taylor, A. A., Dist. Store., M. P., Breakers.
Thompson, C. H., Dist. Store., S. P., Traymore.
Thorrell, C. H., Gen. Store., G. M. & N.
Trudel, J. A., Div. Store., N. H., Princess.
Vaile, G. R., Maint. of Equip. Stkr., Penn., Blackstone.
Wall, W. E., Asst. Div. Store., B. & O., South Carolina.
Warren, H. E., Mgr. Purch. & Stores, Gulf Mo. & Nor., Haddon Hall.
Watson, B. P., Div. Store., C. of Ga., St. Charles.
Watson, J. M., Mat. Clerk, Penn., Wellsboro.
Whalen, T. F., Div. Stkpr., N. Y., N. H. & H., Traymore.
Wharton, J. E., Store., Penn., Blackstone.
White, E. W., Dist. Store., Penn. Pennhurst.
Wilson, Harold, Chf. Clk. 2 P. Dept., U. P., Traymore.
Wise, H. E., Chf. Line Inspr., Penn.
Wright, C. L., Gen'l. Store., M. K. & T., Traymore.
Young, C. D., Gen. Supr. Stores, Penn., Brighton.
Zimmerman, H. J., Store., Penn., Blackstone.

Conventionalities

Harry W. Finnell comes to the conventions this year with a new title—that of general sales manager of the Kilbourne & Jacobs Manufacturing Company.

Jim Anthony, of the American Arch Company, had considerable difficulty navigating the pier on Tuesday, owing to the low visibility caused by the "fog."

F. L. Norton and R. C. Ferguson, New York; George L. Davis, St. Louis; E. S. Wortham, Chicago, and W. L. Jeffries, Jr., Richmond, compose the Scullin Steel Company delegates to the conventions this year.

Andrew C. Louden, of The Superheater Company, is here from Montreal and attended the dance last evening in his own clothes. Fortunately Harry Oatley, his present room-mate, is considerably larger than Andrew.

The rain yesterday made the duties of H. E. Daniels, chairman, and the other members of the Transportation Committee heavy, but they saw that all convention visitors were just as well taken care of as circumstances permitted.

Speaking of coincidences, J. A. Droege, general superintendent of the New York division of the New York, New Haven & Hartford, drew badge No. 567 this year and in 1920. This is attested to by H. V. McKedy, who issued the badges.

The young ladies at the convention are having difficulty identifying A. W. Clokey, of the American Arch Company, on account of the presence of his double here this year. If they will pick the better dressed of the two they will be safe.

John Draney, crack engineer of the Lackawanna, is here for the M. M. program of the Mechanical Division. He has just been re-elected president of the Veterans' Association of the Lackawanna. Incidentally he will celebrate his 37th wedding anniversary while here.

T. H. Beacom, vice-president of the Rock Island, and Mrs. Beacom, joined the Rock Island crowd and spent the week-end at the conventions. Mr. Beacom reports crops and other business prospects in Rock Island territory excellent, and is getting ready for a busy fall and winter.

C. W. Galloway, vice-president of the Baltimore & Ohio, accompanied by Mrs. Galloway, spent the week-end in Atlantic City visiting with friends and looking over the exhibit. Mr. Galloway is enthusiastic over the large amount of business the Baltimore & Ohio is handling in spite of the coal strike.

H. C. Pearce, who came to the conventions in Atlantic City two years ago as general purchasing agent of the Seaboard Air Line, comes this year as director of purchases and stores of the Chesapeake & Ohio. Mr. Pearce is accompanied by Mrs. Pearce and their daughters, Misses Katherine and Marie.

S. B. Cooper, general engineer in charge of project work for the Westinghouse Electric & Manufacturing Company arrived last Monday. He has been with the Westinghouse Company since 1910 and has taken an active part in most of the railroad electrification projects handled by his company since that time.

James B. Regan, president of the Regan Safety Devices Company, came down from New York the latter part of the week for a visit at the convention and exhibit. J. Beaumont, vice-president and sales manager of the company, has been dividing his time between the conventions in Atlantic City and the Signal Division Convention at Spring Lake.

A great booster for 100 per cent. locomotive efficiency is H. F. Grewe, master mechanic of the Akron, Canton & Youngstown. Mr. Grewe is always on the lookout for anything new which will increase efficiency and recently placed an order with the Baldwin Locomotive Works for two Consolidation locomotives, fully equipped with all modern devices.

E. G. Gross, formerly master mechanic of the Central of Georgia, is looking over the exhibits this year in his new capacity as master mechanic and master car builder of the Western Railway of Alabama, Montgomery, Ala. Mr. Gross is president of the Southern & Southwestern Railroad Club, which has grown wonderfully under his skilful guidance.

F. I. Sivyer, formerly president of the Joliet Railway Supply Company, has arrived for a few days at the conventions. While he has retired from its presidency, Mr. Sivyer, in addition to extensive business interests of other kinds, still has a large interest in the Joliet Company. He is president of the Northwestern Malleable Company, and of the Sivyer Steel Castings Company.

The spirit of the "Times" is reflected in the act of Joseph Robinson, of Robinson Connector fame, in having caused a New York daily newspaper of that name to be laid at the hotel room doors of a considerable number of railway and railway supply men each morning during the convention. One of the splendid qualities that commend Mr. Robinson to his fellow man is his thoughtfulness for others.

E. E. Nash, who has resigned as vice-president and general manager of the Minneapolis & St. Louis to become western sales manager of the American Locomotive Company, with an office in Chicago, has arrived to attend the convention. Mr. Nash was in the railroad business for thirty-six years. He was on the Chicago & North Western until 1920, when he went to the Minneapolis & St. Louis.

J. D. Purcell, vice-president of the Dearborn Chemical Company, and president of the Boss Nut Company, has just returned from a visit of some weeks to England. While in London he held a meeting of all the representatives of the Dearborn Company in the various English colonies throughout the world. He arrived in New York late last week and came direct to the convention.

George L. Bourne, America's long distance commuter to England and the Continent, did manage to be on this side of the pond for the conventions. His travels have not been in vain, as may be observed from that little red contraption in the Superheater Company's booth—the exhaust injector. This device is in extensive use in foreign countries and the Superheater Company is introducing it to the American railways.

M. J. Powers, who has been superintendent of motive power of the Colorado Midland for the past four years, is attending the conventions this year. Mr. Powers is in the unique position of having found himself out of a job because of the fact that the railway has suspended operation. Before he went with the Colorado Midland Mr.

Powers was master mechanic of the Denver & Rio Grande at Denver for a period of 10 years.

When F. H. Clark and Robert F. Carr were becoming life-long friends as students together at the University of Illinois over thirty years ago, the "Carr Cup" had not been thought of. A few years ago Robert donated the cup to the McBarmma Golf Club to go to the member making the best net score of the afternoon play, and last Saturday afternoon Frank won it. When Mr. Clark looks at it on the mantel at home it will revive many pleasant memories.

Rhys Morgan, who sang during the entertainment on Friday evening, is a pupil of Madame Del Vallera of New York and is one of the coming American tenors. He is well known to a number of Chicago railway supplymen and their friends. He was formerly a tenor soloist at the Central Church in Chicago, but is now studying exclusively for the grand opera. His production was very much appreciated and the convention was fortunate in this choice.

F. W. Edmunds, known to his friends as "Buckie" Edmunds, arrived with his wife Saturday from Spring Lake, where they attended the Railway Signal Association convention. Mr. Edmunds is secretary of the Signal Appliance Association and is attending the A. R. A. convention this year as a representative of the Sunbeam Electric Manufacturing Company. This is the 39th annual meeting which Mr. Edmunds has attended, and judging from his "pep" he is good for many more.

L. B. Sherman, usually one of the "old reliables" of *The Daily* staff, and Mrs. Sherman were unable to stay throughout the conventions. They went to Hanover, N. H., to attend the commencement exercises at Dartmouth College, from which their son, Booth, graduates this week. "Lu" is a convention veteran in more ways than one. He has been attending thirty years, and was secretary of the Railway Supply Manufacturers' Association in 1906, when the conventions were first held in Atlantic City.

Jack Schurch, of Manning, Maxwell & Moore, brings to the conventions this year an interesting story of a crane installation on Mr. Ford's railway, the Detroit, Toledo & Ironton. At the road's shops in Detroit it was desired to turn the locomotives in the shop, and due to the lack of space the crane department of Manning, Maxwell & Moore devised a rotating crane. It is of the traveling type with the trolley so arranged that it can be turned 90 degrees while under load, the capacity of the crane being 150 tons.

W. L. Robinson, president of the International Railway Fuel Association and superintendent of fuel and locomotive performance of the Baltimore & Ohio, arrived at the conventions Saturday evening with Mrs. Robinson and their eight-year old son, W. L. Robinson, Jr. Mr. Robinson in speaking of the coal situation, stated that the Baltimore & Ohio had not, up to the present time, confiscated a single carload of coal. Their storage piles are just about depleted and the Baltimore & Ohio is purchasing coal where it can obtain it, although it is of an inferior quality.

F. E. Wynne, manager railway equipment engineering department of the Westinghouse Electric & Manufacturing Company, well known to railroaders because of the active part he has taken in the electrification of the Chicago, Milwaukee & St. Paul, the Norfolk and Western, the Pennsylvania and the Chilean State Railways, arrived Sunday to remain until the end of the convention. Mr. Wynne is a graduate of Bethany College and Ohio State University and since 1902 has been continuously connected with the electrification work done by the Westinghouse Company.

As a rule the heads of the mechanical department of all the important railroads are familiar figures at the conventions. One of the exceptions is F. H. Hardin, chief engineer of motive power of the New York Central, who had hardly been heard on the floor until yesterday, when he presented the reports of two of the sub-committees on locomotive construction. Mr. Hardin's railroad experience has been gained entirely on the New York Central Lines, his first position being that of machinist. He recently took an important part in the hearings on repair contracts before the Interstate Commerce Commission.

Le Grand Parish has one big hobby at the convention this year—the new Michigan Central locomotive 8000 which was delivered to that road by the Lima Locomotive Works about three weeks ago. This engine is one of the greatest advances in locomotive design and construction that has taken place for many years. It is equipped with all of the tried efficiency devices; all of the auxiliaries operate on superheated steam and there are many other features entirely new to American locomotive practice. Mr. Parish has several photographs showing all manner of views of the engine and he has been kept fully occupied showing them to his many curious friends.

We all miss the genial smile and glad hand of Scott H. Blewett, of the American Car & Foundry Company, king of the "old timers." Those of us whose memories go back to the conventions of 25 years or more ago recall the splendid work he did in helping to form the present Railway Supply Manufacturer's Association, of which he was the fourth president, and in helping to guide it for several years thereafter. As a matter of fact, up to and including the last convention his counsel was sought much as the young man goes to his daddy for advice at critical stages of his career. Fortunately, however, Mr. Blewett is not ill; but he recently suffered a severe loss through the death of his brother Ben and did not feel equal to making the trip from St. Louis to Atlantic City. With the thoughtfulness that is so characteristic of the man, Mr. Blewett sends his greetings to all those here with whom he is acquainted, and expresses the wish and hope that there may be an old time reunion a year hence.

W. H. Fetner, superintendent motive power of the Central of Georgia, reports some extraordinary savings in fuel consumption on his road. During the month of May, last, all divisions made a saving of 43.9 per cent. in freight service, based on the pounds of coal per 1,000 gross ton-miles; 5.7 per cent. in passenger service, based on pounds of coal per passenger train-mile; and 30.8 per cent. in switching service, based on pounds of coal per switching locomotive-mile, as compared with the same month in 1920, making a general average saving in all classes of service of 22.4 per cent., which in money meant $32,678 to that road. The firemen on the switching engines keep a record of the number of scoops used per hour and they are anxious to improve their service. Local firemen's fuel saving committees hold meetings at every roundhouse terminal to discuss ways and means of saving coal. Frequently the brakemen are invited to these meetings, and discuss methods by which they too may assist in promoting fuel economy. It is by such co-operation that real fuel economy can be obtained.

Second Session of the Air Brake Association

Illustrated Papers on Auxiliary Devices and U-C Brake Were Presented

THE SECOND SESSION of the Air Brake Association was convened at Haddon Hall on Tuesday, June 20, 1922, at 10.00 a.m., with a large attendance. After the opening notices and usual routine business had been attended to, F. W. Brazier, assistant to the general superintendent of rolling stock, New York Central, made a brief address. Mr. Brazier has for years taken a keen interest in the Air Brake Association and has rendered considerable assistance in carrying on its committee work and investigations.

Remarks by F. M. Brazier

Mr. Brazier called attention to the fact that he had come up through the ranks to the highest position in the car department of the New York Central. This he attributed to always doing more work than he was actually paid for anl not devoting his main attention to seeking for a promotion.

Attention was directed to the valuable educational work of the Air Brake Association, work that can be carried out in no other way. In this respect the association differs from the M. C. B. Association, whose work has been largely of a legslative character. Unfortunately many railroads do not yet maintain their air brakes in the effective condition that they should, which indicates the need of a continuance of the good work which the association has always carried on. By greater co-operation and support of higher officers, far more might be accomplished to the great advantage of all railroads. The interest and sacrifice which many members of the association show by attending the annual meetings on their own time and at their own expense is something that they would not be called upon to do, if the importance of these meetings was better understood and the great savings which could be secured by putting into effect the practices brought out in the association meetings, were realized.

Air-Operated Auxiliary Devices

The first subject taken up was the committee report on auxiliary devices, presented to the executive committee in 1921. The report, in the absence of C. H. Weaver (New York Central), chairman, was read by C. B. Miles (Big Four), following which R. E. Miller (Westinghouse Air Brake Company), showed and explained lantern slides of the various diagrams and charts used in the report.

This committee, which was appointed subsequent to the meeting of the association in Cleveland, May, 1918, presented preliminary reports in 1919 and 1920 and a complete report to the executive committee in 1921. An abstract of this report was given in the *Railway Mechanical Engineer,* August, 1921, page 484.

The object of the work done by the committee was to obtain information concerning the air consumption of various locomotive auxilliary devices other than those belonging to the air brake, such as air-operated firedoors, bell ringers, cylinder cocks, reverse gears, sanders, water cocks, coal pushers, etc.; to establish and follow up a code of tests for such devices; to devise a convenient system for recording and reporting a maintenance program from the standpoint of cost and benefits received; and to obtain data as to costs and factors involved in such a maintenance program. In the work carried on; auxiliary devices for both steam and electric locomotives were given consideration.

Several forms for test reports were presented and instructions given relative to their use. Information was given in regard to the number of various auxiliary devices in service, the average number of times each are used per day, the length of time in service, the quantity of air consumed and the money value of this air. The value of the savings which might be effected by reducing the air consumption to the limits established by the code was calculated, and the possibilities were shown to be vastly greater than commonly realized. A convenient method for applying condemning limits to tests of auxiliary devices was described, together with a test code. The report closed with conclusions and recommendations which were clearly stated.

The maintenance programs which were reported according to the plan show results that would be hard to credit if it were not possible to check up the records by comparison. The tremendous margin for economy is more evident than it has been in any of the data submitted previously by this committee. The yearly saving of more than $45,000 for a railroad system that uses less than 1,000 locomotives is remarkable. Of course, this value is based on cost of testing and repairing all auxiliary devices at least once a year. It might be possible that the average need of repairs would prove to be more than once a year for each device. In such event, the savings figures would be reduced by the increased cost of repairs, but this reduction would not seriously affect the margin of saving. The figures show that the frequency of repairs could be increased to four times a year or once every three months for each device and still permit a saving of more than $36,000. It should be borne in mind that this saving does not take into account the large benefits derived in the way of more reliable and efficient auxiliary device operation. Locomotive failures and expensive delays are frequently chargeable to auxiliary devices when the latter are poorly maintained.

Standing tests show that the average condition of auxiliary devices on steam locomotives is far below the standard that should and can be maintained. Figures obtained from tests made last year are not much different from those presented in previous reports and they confirm all the original conclusions.

The electric locomotive auxiliary device tests indicate that many of these devices use much more air than should be required for the functions they perform. The consistently low minimum values of the air consumption rate found on most types of devices show that their condition is about on a par with that of auxiliary devices on steam locomotives. It will be noted that very high rates of air consumption were observed for some of the devices; in fact, the larger of these values is much in excess of anything experienced in tests made on steam locomotives. The average rate for alarm whistles is more than 500 cu. ft. per minute, and the maximum on one whistle was as high as 1,180 cu. ft. per minute, or about 25 times the nominal capacity of the C-60 compressor commonly used on electric locomotives. This rate is equivalent to an orifice ¾ in. in diameter and no doubt this whistle is like the one made famous by Mark Twain.

The report, which is one of the most valuable ever presented before the association, was signed by C. H. Weaver (New York Central); C. B. Miles (Big Four); W. W. White (Michigan Central) and R. E. Miller (Westinghouse Air Brake Company).

Address by Frank McManamy

The convention was addressed by Frank McManamy, manager department of equipment, United States Railroad Administration. Mr. McManamy spoke of the especial interest which he had always taken in the affairs of the Air Brake Association, referring particularly to the relations which had existed during the period of federal control. He dwelt on the importance of the air brake to railroads, the one device of which every one having to do with railroad operation must have a reasonable working knowledge. This fact, he stated, placed the air brake on a par with the standard operating rules. It was his opinion that the Air Brake Association should be held responsible for the standard rules governing the maintenance and operation of air brakes.

The opinion was expressed that the air brake man was not aggressive enough in the matter of bringing his needs to the attention of operating officials. He reminded the men present of the fact that although chronic kicking was not the best thing either for a man or for an organization, it was the "squeaking wheel that got the grease."

The air brake man must have the faculty of successfully dealing with men, not only men who are under him, but with men who are above him in rank.

U-C Brake

An interesting illustrated, descriptive talk on the U-C brake was presented by J. C. McCune on behalf of the Manhattan Air Brake Club. In addition to the use of lantern slides, moving picture films showing the operation of the U-12 universal valve were also displayed. The talk took up the steps which led to the development and design of the U-C valve, not only the steps immediately following the Lake Shore tests in 1919, but also the earlier progress in air brake evolution. The operation of the valve was well covered, as would not have been possible without the use of lantern slides.

Following this a number of slides and moving pictures were thrown on the screen by P. O. Warren, of the Picture Service Corporation, Chicago. The pictures shown were of gasoline engines, carburetors, refrigerating machines, etc. They were first prepared and used effectively during the war in educating men undertaking new lines of work. Since then they have been found useful by a number of manufacturing concerns in the training of apprentices and workmen.

Air Brake Appliance Association

The following members of the Air Brake Appliance Association have exhibits at Haddon Hall. This is in addition to space on the pier occupied by them and by various other firms manufacturing air brake appliances.

Ashton Valve Company, Barco Manufacturing Company, Clark Company, Crane Company, Joseph Dixon Crucible Company, J. B. Ford Company, Johns-Manville, Inc., The Leslie Company, Harry A. Montgomery, New York & New Jersey Lubricating Company, Pilot Packing Company, Railway Review, Simmons-Boardman Publishing Company (*Railway Age*, Railway Mechanical Engineer, Railway Electrical Engineer, Railway Signal Engineer and Railway Maintenance Engineer) and Westinghouse Air Brake Company.

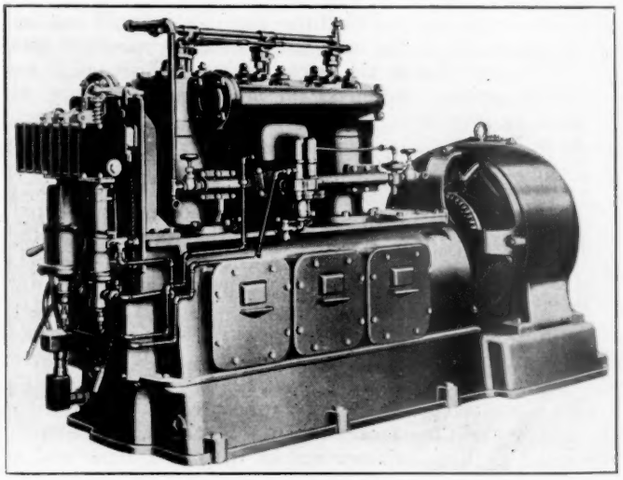
New Devices Among the Exhibits

Westinghouse 3VS Motor-Driven Air Compressors

THE WESTINGHOUSE-NATIONAL 3VS motor-driven air compressor, exhibited by the Westinghouse Air Brake Company, Pittsburgh, Pa., is especially suited for railroad work—to supply air for yard charging plants, signal operation, and for general shop use. It is designed for continuous operation, having water jacketed cylinders and cylinder heads, with forced water circulation. Various sizes are available to suit the volume of air and pressure desired. The compressor is driven by a direct or alternating current motor which may be wound to suit a great Variety of voltage and current conditions.

The outfit is very compact, as the compressor, motor, and control system form one complete self-contained unit. It is of the single stage, single-acting type with three vertical air cylinders. Placing the cylinders vertically eliminates uneven wear on the piston and cylinder walls, reduces vibration to a minimum and assures quiet operation. All parts are carefully made of the best materials, and liberally proportioned to withstand long usage. Adequate and positive lubrication for all working parts is provided automatically.

The automatic control is a distinctive feature of importance. It starts and stops the compressor when the minimum and maximum pressures have been reached in the storage reservoir, so that the current consumed is in proportion to the air used, and the outfit does not require



3VS Direct Current Motor-Driven Air Compressor

constant attention by an operator; it unloads the compressor during the accelerating period; it restricts the flow of current to that actually required to accelerate the compressor (unloaded) in the shortest time possible without exceeding full load running current; it restricts the use of cooling water to the operating period; it protects polyphase motors from single-phase operation by means of an underspeed release device; it obviates the necessity for the use of a circuit breaker or any protective device other than fuses; it prevents starting of the compressor if there is insufficient oil supply in the crank case. By virtue of the complete automatic control, the most satisfactory and economical operation of the compressor is assured.